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THE KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY.

EDITED BY

THEO. S. CASE.

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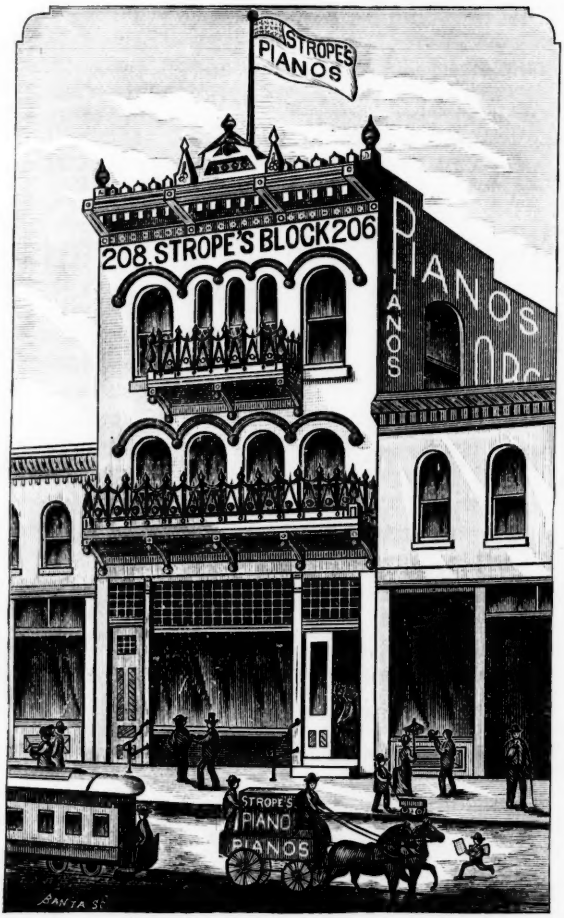

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REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VII. DECEMBER, 1883. NO. 8.

GEOLOGY AND MINERALOGY.

THE TRIASSIC BEDS OF TEXAS.

CHARLES H. STERNBERG.

The Red River and Big Wichita receive their characteristic color from the extensive red clay beds along their valleys. These deposits have been called Triassic by most geologists. Professor Cope claims they are Permian, and that the vertebrate fossils are similar to those found in the Permian shales of Illinois. They have been but little studied and offer a rich field for the stratigrapher and palæontologist. For miles along the Big Wichita are thousands of acres of the rich colored strata exposed. So persistent is the red color that all the surface waters are colored. On examination the water will be found to hold red clay in solution and though on still days the clay is partially settled, the least wind will make the water almost as thick as cream. As there is no other water but that which is impregnated with salts of magnesia we were obliged to drink it, I found that boiling would settle it, as would also the bruised leaves of the prickly pear. Some of the scenery along the Big Wichita is very beautiful. The miniature Bad Lands are made up of pinnacles, ridges, cones, hills, etc., composed of red and green clays interspersed with layers of grey sandstone, some of which has such a fine grit that it can be used for sharpening razors or other fine instruments. I spent several months among these beds in search of fossil vertebrates for Harvard University, in the winter of 1881. The Triassic beds are covered with yellowish sands and clays of quite recent age, containing the remains of the elephant,

mastodon, horse, camel, turtle, etc. I discovered one shell that was over three feet long, unfortunately it fell to pieces. I got quite a number of bones and teeth of these animals.

There are large beds of massive gypsum in the Triassic, as well as narrow seams crossing the beds at various angles: some is of the fibrous variety and white as snow. Nearly all the clay beds are filled with concretions of all the shapes imaginable. They cover all the beds.

For many weeks I searched these beds for fossil remains without success: they were remarkably barren. Week after week passed and I was well nigh discouraged when I was so fortunate as to find a large reptile, and thereafter I was very successful. I also found seven Ganoid Fishes; their peculiar enameled scales are quite abundant. Some of the reptiles appear to belong to the Labyrinthodonts. One fine specimen resembled a crocodile, the bones were all beautifully sculptured: it was provided with a row of round teeth. I think it was about twenty feet long and four crocodile-like limbs.

Another species, a land reptile, was of large proportions. The hind limbs were long and powerful, and it had a large tail. The front limbs were provided with claws; so it doubtless walked on its hind feet.

Some of the bones were changed to iron ore and were very heavy. One swimming species had two rows of teeth in each jaw, long and short ones. The bones were all sculptured. I discovered a great many loose teeth, three of them projecting from one root. One large animal I discovered had bi-concave vertebræ and long well preserved limbs, with hoofs on hind feet and claws on front ones. I got a lot of sculptured dermal plates. I passed the winter on these beds, and every week or two we were overtaken by a dreaded "norther," and the ground would soon be covered with sleet and ice. The explorer always suffers a great deal from exposure. He is away from all the comforts of civilization; absent from home and friends. He works with unfailing enthusiasm and is happy if success crowns his efforts. If he discovers new species and adds new facts to science, he is well rewarded. To his work are the recent advances made in palæontology largely due. In the interests of science there is no place on land or sea that he will not explore. Enduring the heat of the tropics or the extreme cold of the north in pursuit of his beloved science, and the glory of the whole is that nature always rewards persistent effort in searching out her hidden treasures, and when they are found there can be no sensation so gratifying as the explorer feels over each new discovery. He is quick to read the mighty volume the Creator has written in the solid rock. Each stratum is a leaf in which he has written in never fading characters its life and history; written so plainly that there can be no mistake. The geography, climate, depth of sea, etc., of each succeeding era in the world's history are carefully inscribed. On the Little Wichita I discovered a great many well preserved specimens of ferns, etc., that closely resemble those of Permian rocks, a strong proof, to my mind, that the beds are Permian. They lie immediately under the old beds. My collections have not as yet been described or I would be able to give a more detailed account

of them. I found enough to prove that in the days when these rocks were forming, the land and sea were peopled with animal life on land; great carnivorous and herbivarous reptiles were abundant; the climate was tropical and plant-life luxuriant.

Copper ore is found in this formation and a smelter has been erected at the Narrows to reduce the ores. The Narrows are named from a place where the divide between the Brazos and Big Wichita is so narrow that a wagon can hardly pass. It is difficult traveling along the rivers, as deep drainage canals cut through the valley and have to be headed. I have often travelled fifteen miles in going three in a straight line. The woods were filled with wild turkeys, and our table was well supplied.

The Triassic beds have been thrown up by internal forces into miniature mountains, and their trends can be followed for some distance. The rocks lie at all angles. The color of the beds change so often that it is hard to trace them.

Thanks to a letter from Mr. Lincoln, Secretary of War, to commanders of western forts, I had, thanks to Major Henry, Commander of Fort Sill, placed at my disposal a large government wagon and six mules, with escort of four soldiers and a teamster, with wall-tent, rations, etc. And here I would express my hearty thanks not only to the officers of Fort Sill, to whom I am under many obligations for similar courtesies extended and help rendered, but to all army officers who have always felt great interest in all scientific expeditions, and have done much to make them successful. It is to be hoped that Texas will soon be more thoroughly explored. It offers a most interesting field of research. The landscape artist would also find some beautiful scenery.

GENESIS OF NATIVE COPPER.

JOHN K. HALLOWELL.

Having expressed some ideas relative to the method of occurrence of native copper, and also being requested to make the same public through some journal of standing, I have taken the liberty of sending the REVIEW the following:

In order to express my views clearly I will take the Lake Superior copper occurrences as a final illustration, at the same time I feel how difficult it will be to set the whole upon paper plainly, that any one may understand, especially those who have not much knowledge of rocks and ore formations. There is not much in the books that is at all satisfactory to me; the basis of reasoning there, being, in most instances, theoretical and far fetched, and the simpler things, even though occurring on a very large scale, appear to have been overlooked.

To get at the genesis of native copper let us see what the first form of the ore occurrences is. Mineralogists as well as geologists are agreed that this is in the condition of sulphides, being a deposition, or precipitation from aqueous

solutions, known also as copper pyrites, the ore being a mechanical combination of copper, sulphur, and iron. These pyritous ores are known to occur in very large quantities, sometimes is well defined veins, also as deposits, being worked not only for the copper values, but also for the gold and silver occurring with them; this is the case with the Colorado copper ores. They are also extensively worked in Canada, Spain, and other parts of Europe, and I am quite certain also in the Southern States of this country, for sulphuric acid as well as the copper product. Where utilized for the acid, the ores are found to exist in very large (so-called) deposits con bined with a silica gangue; and surprising as it may seem, even where such ores have been worked for centuries in Europe, I know of no record which states that they have ever been worked out.

Having got our copper into this condition, and exposed to atmospheric agencies, the next step in nature is, apparently to undo what she has so laboriously built up. Without taking time into consideration at all, comparatively speaking, copper pyrites are very readily acted upon by meteoric agencies, that is, rains, frosts, and snow waters help the ores to oxidize, the sulphur is set free, washed out, and the residue is oxides of copper and iron; notably the green and blue carbonates of copper.

Now the salts of copper in this condition are much more soluble than the iron oxide, which results in a continual leaching process gradually carried on for ages upon ages, until all of the copper is leached out from amongst the iron, and accumulates further down amongst the vein matter, quartz; this concentrated oxide is generally cuprite, or red oxide of copper, very rich, and giving over fifty per cent metallic copper. With no geological disturbances in the immediate locality this gradual change would keep on until all of our first formed pyritous ores would be changed to concentrated copper oxides; concentrated at times to such a degree as to actually show spots, crystals and other small particles of really metallic copper, as a natural occurrence.

Let some slight geological change now occur, by which the iron ore of the surface is eroded away, exposing the large mass of accumulated copper oxides. We have the illustration of this method of occurrence in New Mexico and Arizona; where the most easily reduced of all copper ores are found in the form of almost mountains, or vast deposits of copper oxides, and the product from these is, to-day, successfully competing with the Lake Superior product.

The metallic copper from the Lake Superior mines is the purest form of native copper now known, and the duplicate of this region has been widely sought for on the American continent for many years, but so far unsuccessfully; or at least if found, there has not been any attention attracted to it, as would naturally be the case if found in fact; but this is digressing somewhat.

Having shown the first two steps of copper occurrence as known, it remains to reason out the Lake Superior copper region from the last explained.

We can rightfully assume, for illustrative purposes, that we have a very large formation of quartz, mineral bearing, originally containing copper pyrites, which through ages of time, under the conditions described, have changed to the con-

dition of copper oxides, and that by surface erosion the iron gossan, or cap, has been removed; the surface quartz from the leaching out of the sulphides is honeycombed, loose and friable. Now let a geological change come, by which in the subsidence of a large area of dry land, our copper deposit is submerged many thousand feet under an ocean.

The weight or pressure of all this water, would act in making our formation more compact. If we could see it then, we would find a vein, or mineral bearing quartz, iron and copper stained, amongst the top layers, packed firmly together, but if taken from under this pressure of water, easily disintegrating; and further down in the gangue we would keep getting a greater proportionate showing of copper, owing to the previous leaching action already described, but it will not do to take our deposit out just yet.

Let us go outside in our reasoning a little; all of the large masses of eruptive rock known, except lava of recent date and pumice stone, have been thrust up, in the form of volcanic pastes, through the earth crust, or floor under an ocean. Now if such were to happen, in near proximity to our copper oxide deposit, the result would be, from the heat and pressure of such an occurrence, that all of our oxides would gradually change to native, or metallic copper. I reason, gradually, as the pressure and presence of such an enormous mass of water would prevent the copper melting as in a furnace. It would produce such changes as would be best described by the word metamorphism. The quartz also would be metamorphosed into a very much harder form and be more homogeneous in texture, but with scales of native copper all through, these of course increasing in quantity as depth in the formation is gained.

If this quartz had cavities in it before the submergence, which could have been filled with the copper oxides during the leaching period, then there would be found in places large masses of native copper, and which are found in Lake Superior regions, the result or product of just such a natural process as I have described.

There, as is well known, we have trachytes, basalts, and porphyries in vast amounts, and it is owing to these being erupted under the conditions described, and in near proximity to what had been, in the past, a duplicate of the Arizona copper formations, that we have the pure form of metallic copper as a natural occurrence upon the shores of Lake Superior.

Now, if ever a duplicate of the formation of this region is found it will also be found that surrounding it, perhaps also on top, (the result of a flow of volcanic paste) will be found some of the varieties, and in very large quantity too, of eruptive rocks; if so, then the copper product will duplicate that of the Lake Superior mines in quality, with perhaps this chance for variation in quantity. That perhaps the quartz did not contain cavities to allow of the accumulation of large masses of copper oxides, hence there will be no large masses of native copper, but the metal will be evenly distributed throughout the whole of the quartz, not varying much in quantity in planes of the same horizon, but rapidly increasing throughout the whole of the mass as depth is gained in the formation.

It might be that the surface quartz would be barren, or that there would be only the smallest scales of copper amongst the surface material; but the quartz, or gangue, would show for itself whether it had been through the course of change I have described; and should such ever be found, it would be, to my mind a very safe thing to go down upon, especially if occurring in a large bed, as then it would have the chance of being as inexhaustible as anything known at Lake Superior.

DENVER, COLORADO, November 7, 1883.

THE PLUTON GEYSERS OF CALIFORNIA.

* * * * * * *

Although only a hundred miles from San Francisco, it is an all day's journey to the Geyser Cañon. One travels by train from eight to eleven o'clock in the morning, first crossing the Bay of San Francisco and the Straits of Carquinez by ferryboats, and then speeding up the famous Napa Valley to that point where the mountain ridges meet and seemingly bar all further progress, the great stage ride of twenty-seven miles from Calistoga to the geysers begins. There is one spring in that narrow little "Devil's Cañon" for every ailment in the doctor's category; the iron, the sulphur, the alum, the magnesia, and the epsom salts, boiling and gurgling away at all temperatures and in all combinations, and as we wound our way up that tortuous cañon the guide continually did tempt us with his cup full of some steaming draught.

The shifting clouds of steam and the cañon walls streaked and daubed with brilliant patches of color make fine pictures to the eye every moment, but no photograph can do justice to it, and only a well executed aquarelle could give an accurate view of this vivid, diabolical and unearthly realm.

Although this group of hot and boiling springs have long been denominated geysers, they are not geysers at all, and there are no eruptions of columns of water or the recurrent bursts of water and steam to great heights, which characterize the geysers of Iceland, New Zealand, and the Yellowstone. One inky pool, of unknown depth and a diameter of seven feet, boils away at a furious rate, but even this witches' caldron does not authorize the ambitious name that designates this collection of boiling springs and steam blow-holes. The heat and steam have so decomposed the rocks through which they find vent, that one can thrust his stick into what appears to be solid rock, and the ground jars and trembles beneath any heavy or emphatic footstep. At the head of the cañon there is the inevitable Devil's Pulpit, from which the ruler is supposed to view his realm. In the early morning and at sunset the cañon is one cloud of steam, and prosaic human figures seen through that misty and shifting medium are suggestive of all the witches, goblins, and demons that haunt the fairy tales and the Brocken; but, at noon, when the hot sun pours straight down into the cañon, the steam rises in faint and fitful gusts, and the wonderful coloring of the cañon

walls is seen at its best. Cinnabar streaks the sides with red; magnesia lies in great white masses; sulphur crystals form yellow patches around each little steam-hole, and rocks are covered with blue and green compounds of copper that have condensed from the heavy fumes. Tossed together in the wildest way the rocks show all these vivid tints, while the general effect on the eyes is the endless range of reds and yellows. The puffing, steaming, and sputtering holes in the hillsides culminate in the great tea-kettle's spout, which emits a hoarse blast of steam that makes the guide's cup whirl like a fly-wheel when he hangs it on his stick and holds it across the orifice.

The Indians knew this cañon ages ago, and it is not many years since they tore down the rude tepee that they had built over one of the springs for a sweat bath. The old men were cured of their rheumatic woes by the sulphur steam, and marvelous effects are now produced on the white man who dares to "sulphur the deep damnation" of one of the steam baths provided at the bath house near the hotel. The bath house is built over a collection of boiling sulphur springs, and the patient, or the victim, is first conducted to a box of a room where the steam creeps in at every crack of the floor as hot as it came from the center of the earth. After a thorough parboiling there comes the hot and tepid showers, a plunge into a tank of cold sulphur water, and then a glow and a rapturous and delightful sensation of having grown twenty years younger and spryer.—*Cor. Globe-Democrat.*

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION NOTES.

In a paper read before the Mathematical and Physical Section, Professor Chandler Roberts remarked on the rapid diffusion of molten metals. The two metals chosen were lead and gold enclosed in a U-shaped tube, the lead occupying the lower portion of the tube, and the gold being put in at the top of one limb. After about forty minutes Professor Roberts found that the two metals had been thoroughly mixed. Sir W. Thomson called attention to the extreme importance of this, with reference to metallic alloys, and remarked that it resembled the diffusion of gases or of heat in a gas rather than of a solid in a liquid. Salt would take years to diffuse in a similar manner through water.

A paper was read which had been received from two American gentlemen, Messrs. W. B. Scott and H. F. Osborne, upon the "Origin and Development of the Rhinoceros Group." These gentlemen have made careful researches in the extensive series of tertiary lake deposits in the northwestern United States, in which specimens of very many animals have been discovered, which render it possible satisfactorily to trace the genealogy of several important groups of mam

mals. These gentlemen have discovered the remains of the ancestor of the rhinoceros group,—an ancestry from which it is found that both the rhinoceros and the tapir groups are descended. This animal has been named Orthocynodon. A somewhat detailed account of the anatomy of the skull and form of dentition was given, bearing out the authors' views.

The committee on Meteoric Dust state that Mr. Pope Hennessy had obtained a quantity of ice and snow from the Himalayas. After being melted and boiled down the residue was sent to England for examination. In most specimens of the dust are a number of small spherical bodies of magnetic matter, the surfaces of which are generally highly polished. Dr. Schuster showed several of these particles, the largest being perhaps one-twentieth of a millimètre in diameter, which had been obtained from a spot in the Himalayas about 3,400 feet high and fourteen miles from any human habitation.

Sir R. W. Rawson stated that, according to the observations of the Anthropometric Committee it appeared that from the top of the social scale to the bottom there was a gradual descent in stature, weight, chest-girth, and all the elements of strength. It was therefore of the utmost importance that by nature and improvement of sanitary conditions the lowest should be raised to the level of the highest.

Dr. Schuster read an interesting paper on the motion of the Swiss glaciers. It has been known for some time that there are long periods of time during which the Swiss glaciers advance down or recede up their beds. Thus, in 1741, they were advancing, but it was reported that in 1700 it was possible to walk from Chamounix to Courmeyer over the Col de Géant without touching ice. They advanced all last century as far as is known and up to 1817, then went back until 1840, advanced till 1859, and have since been receding till the present year, when many, including the Mer de Glace and the Rosenlaui glacier, have begun to advance. Dr. Schuster has made observations this summer on the Glacier des Boissons, at Chamounix, and has arrived at the important conclusion that the rate of motion of the same point on a glacier changes greatly from day to day. Thus he showed that while during the day the hourly rate of motion of one point observed was only .6 centimètres, during the next night it advanced at the rate of 5·5 centimètres per hour. The rate of other points examined varied, but not so greatly. Dr. Schuster also noticed the change occurring at the foot of the glacier when it comes into the valley. The downward motion of this point is determined by the fact that the parts above advanced more quickly than the ice at the foot melts away. He found that on one side of the glacier, where it rested against a boulder, there was no apparent change in the outline of the ice or in the position of the boulder during the day, while at the other side the end had moved in the same time four or five feet.

A paper was read by Mr. E. B. Poulton on heredity in cats with an abnormal number of toes. The peculiarity appeared in the third generation and in succeeding generations. All varieties between the normal four and the extreme seven toes had been observed. The females most frequently possessed the abnormal

number of toes. They were very clever at catching mice, and readily learned to shake hands. The President said the importance of such observations lay in their bearing on heredity. Reasons had been advanced to show that man was descended from a six-fingered animal. Miss Buckland said she had seen in Bath a cat with seven toes on each foot. Professor Marshall remarked on the importance of such observations in relation to investigations as to the origin of species.

Mr. Adam Sedgwick gave an account of the Periodatus—a slug-like animal which he found in South Africa, and of which he exhibited specimens. The animal, he said, had only recently been discovered, and he made a special visit to the cape to obtain specimens. Special interest attached to it, as it had no living relations in the animal kingdom. It was a survival of a type of animal which at some ancient time in the world's history was represented by a greater number of forms. The animal lived in the roots of rotten trees, and it had probably survived on account of its habits and the difficulty of finding it. Since its first discovery the animal had been found in New Zealand, South America, and other parts of the world.

Dr. Stone read a paper on the electrical resistance of the human body. He began by observing that the application of this powerful force to the organism in a scientific manner was still in embryo, and that the results had hitherto fallen far below what might be expected. The main difficulty in obtaining this resistance lay, first, in the difficulty of making good contact through the skin of a living man, and, secondly, in the rapid electrolysis which takes place in the tissues when a current passes through them. The resistance of the skin, he thought, had been greatly overstated, and might easily be overcome by very large electrodes saturated with a conducting solution. The electrolysis was checked by alternating contacts and momentary duration of the current. In this way he had obtained very satisfactory results—among others, the interesting physiological observation that a man of 5 feet 6 inches in height, another of 6 feet 3 inches, and the Hungarian giant, who was 8 feet high, nearly all gave from the wrist to the ankle a resistance close upon a thousand Ohms, the larger man being decidedly the better conductor. The influence of temperature and of disease was also adverted to, the body apparently following the law of solid conductors, increasing in resistance with heat and becoming a far better conductor when suffering from paralysis than in the condition of health.

Dr. Stone also read a paper on some effects of brain disturbance on the handwriting. It was not surprising, he said, that affections of the cerebral hemispheres competent to interfere with the complex co-ordination of speech should also show their influence on the similar act of writing. Essentially both functions were acquirements which by practice had become automatic, and were put forth involuntarily. He said, therefore, that as the defect known as aphasia might occur in different parts of the circuit, so might graphic modifications. Three such cases he described, one of which occurred to himself personally. After sustained mental effort, he fell down in partial state of insensibility. During three weeks delirium and delusions predominated over physical depression.

These were broken, however, by lucid intervals. The leading feature of all his aberrations seemed to have been reduplication. He doubled the number of his sisters, his nurses, and his medical attendants. When he returned to himself and could trust his memory and senses he found two things—first, what he had been accustomed to call aphasia; secondly, that he could not write as he intended. The tendency to reduplication, which was obvious in his delusions, was as clear as need be in his writing, and the trick of including otiose letters in familiar words lasted for some time. It was probably the trace either of mental stammering or of diplographia, depending upon want of synchronism between the two hemispheres of the brain. That such a condition of the ocular muscles occurred in drunkenness was well known.

Mr. E. P. Culverwell read a paper on the probable explanation of the effect of oil in calming waves in a storm. He said when the surface of the sea had become smooth after a storm it was very common for long rollers to break on a sand-bar. If there were no wind and the sea was glassy, these would not break until quite close to the shore, even though the ordinary theory pointed to their breaking earlier, unless there was a force directed opposite to that of their motion. When exerted on the waves, such a force might be supplied by the wind; but if it rose in any direction the waves broke much sooner. This result was, therefore, due to some secondary effect produced by the wind pressure, and not directly by the pressure itself, and it was to the ripples produced on the surface, which disturbed the wave motion, that the speedy breaking was to be attributed. It was, however, a direct result of the theory that the ripples depended on surface tension for their propagation, and could not exist in large amount on the oiled surface. It was also evident that the hold of the wind on the wave was greatly decreased by the absence of ripples, and thus the oil acted both to prevent the wind having much effect on the surface, and also to modify the motion of the water in the wave.

Professor Stokes read an important paper by Dr. Huggins on coronal photography without an eclipse. In a paper read before the Royal Society some time back, Dr. Huggins had shown that it was possible by isolating, by means of properly chosen absorbing media, the light of the Sun in the violet part of the spectrum, to obtain photographs of the Sun surrounded by an appearance distinctly coronal in its nature. These researches have been continued, using a reflecting telescope, by the late Mr. Lassell, and a film of silver chloride as the sensitive plate, on which the photograph is taken. These plates are sensitive to the violet light only, and therefore it was unnecessary to use absorbing media, which had proved a source of difficulty, to sift the light. Fifty photographs in all were taken and examined afterwards by Mr. Wesley, who made drawings of them for the paper. The details shown agree well with the photographs of the corona made during the late solar eclipse, the agreement being specially marked in two cases, dated April 3d and June 5th. The photographs have been seen by the observers sent to Caroline Island to observe the eclipse, and one of these writes that Dr. Huggins's coronas are certainly genuine up to 8′ from the Sun's

limb. Dr. Ball, who was in the chair, examined some of the plates, and spoke of the interest and importance of this communication.

Mr. Litton Forbes stated that the territory of Arizona is now practically opened up for the first time in its history by the completion of the new Atlantic & Pacific railway. The port of Guaymas, on the Gulf of California, probably in the not far distant future will be the port of arrival at least for mails and passengers bound eastward from Australia, China, and Japan. At present Guaymas is a small Mexican town, consisting of adobe houses. Its harbor is excellent—one with deep water up to the very shore, and well sheltered from every wind. It is the only possible mail station on the Gulf of California, and is some 500 miles, or nearly two days' steaming, nearer Australia than San Francisco. Of all the western territories, Arizona has long been the most remote and inaccessible, and, therefore, the least known of all the territories. The aridity of the climate and the presence of hostile Apache Indians have had much to do with this. Arizona is a country of extraordinary mineral wealth. In many parts of its extensive territory it offers large tracts of excellent land to the farmer and stock-raiser. Its chief drawback is a want of water, but this can be supplied by irrigation works and by artesian wells. Coal, salt, and precious metals exist in larger quantities probably than in any of the western mining territories. The copper mines are even now the richest known. The area of the territory is about 114,900 square miles, or approximately 73,000,000 acres—in other words, three times the size of the State of New York. The general topography of the country is that of a plateau, sloping towards the south and west from an altitude of 7,000 feet to the sea-level. The surface of Arizona is much diversified, and contains some of the finest scenery in North America. In no country can the evidences of past geological action be better studied. The cañon of the Colorado is a stupendous waterwork chasm, 400 miles long and from a quarter of a mile to a mile and a quarter in depth, and the scenery in many parts is grand and impressive.

A note on some recent astronomical experiments at high elevations on the Andes was contributed by Mr. Ralph Copeland. At La Paz (elevation 12,000 feet), he saw stars with the naked eye, when the Moon was full, that are with difficulty seen in Europe without artificial aid. At Puno (12,500 feet), Canopus, Sirius, and Jupiter were visible to unaided vision from one to twenty-five minutes before sunset. A number of small planetary nebulæ and stars, with very remarkable spectra, were found in the southern part of the Milky-Way, by searching with a prism attached to a 6-inch telescope, on Professor Pickering's plan. The most remarkable stars showed spectra of little more than two bright lines, one near D, and one beyond F, with a wave length of 467 mmm., which the author, in conjunction with Mr. Lohse, had observed in the spectra of various nebulæ; γ Argûs is a star of this type, with the addition that the line near D is threefold. Several close double stars were discovered. At Vincocaya (14,360 feet) the solar spectrum was very much increased in brightness at the violet end. The solar prominences were seen with nearly equal ease in C, D_3, F, and Hγ. With

ctroscope of lines were visible beyond H and H_2. The solar corona was not seen, nor were any lines discernible in the spectrum of the zodiacal light, although that light was sufficiently bright to be very obvious when the Moon was eight days old.

Dr. Copeland made also several interesting meteorological observations. Black bulb temperatures up to 205·5° F. were recorded, this being the limit of the tube of the instrument, and not the actual *maximum*. With the black-bulb thermometer more than 13° above the local boiling-point, the wet-bulb was below the freezing-point. At Arequipa (7,500 feet), the relative humidity of the air was as low as 20 per cent, and not much higher at other stations. The author believed that an observatory might be maintained with great facility at a height of between 9,000 feet and 12,000 feet, the night temperature being little below the freezing-point at any season. Beyond that height an increased elevation of 150 feet roughly corresponded to a fall of the thermometer of 1° F., and a depression of the barometer of 1-10th inch, so that at 15,000 feet very arduous winter conditions were encountered.

Professor Janssen gave an account of his observations on the solar corona, made at Caroline Island during the recent solar eclipse. He stated that in 1870 he had seen, for the first time, dark lines in the spectrum of the corona—indicating, probably, the existence of matter capable of reflecting the solar light. This observation had been confirmed by some observers, while others had failed to obtain evidence of it. He thought that the failure was due to the fact that the telescopes used by most observers had too small an aperture compared with their focal length, so that the amount of light received by the slit of the spectroscope was very small; the luminosity of the corona being very feeble. Dr. Janssen used a lens of 50 centimètres aperture, with a focal length of 150 centimètres to form the image on the slit of the spectroscope, which was one which admitted a large quantity of light. By means of an ingenious arrangement, it was possible to observe with one eye at the spectroscope, while the other noted through the finder the part of the corona examined. Dr. Janssen found a complicated spectrum with many dark lines. In the course of his paper he referred to the measurement by photographic means of the intensity of light, and stated that the corona was about as bright as the full Moon. Dr. Schuster thought that the differences observed at different eclipses, as to the existence of dark lines, might be real, and not due to want of illumination. During the eclipse in Egypt he had succeeded in photographing G as a dark line. He agreed with Dr. Janssen in attributing the reflection of the solar light to meteoric matter, and pointed out that near the Sun there were no lines, so that there the matter was self-luminous. Prof. Stokes was inclined to refer the reflection to the action of small particles of matter shot out from the Sun in the form of vapor, but condensed at a distance from its surface, forming, as it were, clouds of minute particles.—*Knowledge.*

ENGINEERING.

CABLE RAILWAYS IN VARIOUS CITIES.

We find the following account of cable railways in San Francisco, Chicago, and elsewhere in the New York *Tribune*. We append an account of the Kansas City Cable Railway, furnished by Mr. Robert Gillham, Chief Engineer, by which it appears that this line is superior in many points to any yet built.

To the enterprise and mechanical ingenuity of San Francisco are due the origin and practical success of the system of running street cars by means of the endless wire rope or cable, placed beneath the surface of the ground. The first concession for a wire cable road in San Francisco was granted to Gen. Abner Doubleday and Capt. R. L. Ogden, of the army, the originators of the enterprise. Gen. Doubleday's duties taking him from California, all the rights and privileges granted him were sold and transferred to A. S. Hallidie, representing the present Clay Street Railroad Company, to whom the credit is due of perfecting and carrying to complete success the present system of cable roads. Possessed of indomitable energy and great mechanical ability, Mr. Hallidie, under discouraging and disheartening difficulties, persevered until he has brought the system to that point where he is clearly able to establish by actual practice and demonstration its superiority over the general system of horse-power surface roads.

In August, 1873, the Clay Street Hill Railroad Company in San Francisco began business, and since then it has been found to answer all requirements, and to exceed the expectations of engineers and others who had examined the plans previous to the construction of the road. This system is adapted to all metropolitan railroading where the surface of the streets has to be kept free from obstruction and open to ordinary traffic, where locomotive steam engines are not tolerated, or where the streets are so steep as to make the use of horses difficult or impossible.

After the Clay Street Road had been running three years and its practicability had been fully tested, the Sutter Street Railroad Company, whose lines had been for many years unprofitably worked by horses, changed its system from a horse road to a cable road. This company has now over three miles of double tracks operated on this system. The greatest elevation is 167 feet above the starting point. The business of the road was not interrupted for a single hour during the transformation. The saving in expenses, as stated under oath in testmony given in a suit affecting the company, amounted to 30 per cent, and the passenger traffic was increased 962,375 the first year after adopting the cable system. The shares of the Company were selling before the transfer at $24. They are now worth $60.

The next road built on the cable principle was the California Street Road which traverses the steepest street in San Francisco, the grade being 500 feet in 12,000. This has given easy access to property which previously was of little value, but is also the site of the palatial residences of ex-Governor Leland Stanford, Mrs. Mark Hopkins, and Charles Crocker, costing $1,000,000 each. The next street supplied with the cable system was Geary Street, a comparatively level thoroughfare, but one of the most populous in the city. Its length is 13,200 feet, and it possesses two elevations of 350 and 280 feet respectively. The Presidio and Ferries Cable Road has a five-foot gauge, and 10,000 feet of double track ascending one hill 246 feet above its starting point in a distance of 5,000 feet, one portion being an up-grade 78 feet in 412, or 1 in 5 3-10. The grip is the same used on Clay Street, but made heavier. A road has been built under these patents in the City of Dupedin, New Zealand, 3,500 feet long, which ascends 500 feet in that distance. It has a single track line, with two turnouts or sidings, both parts of the rope running in opposite directions in one tube except at turnouts. It has two curves of 215 feet radius forming an 8.

The Chicago City Railroad Company's cable line in State Street is 4 7-10 miles long, with double track five-foot gauge, and runs on a very busy street, almost level. The president of the road says, in reply to the question how the system worked last winter during cold weather and snows: "We have run smoothly and without the loss of a single trip during the entire winter, although the frost, by actual measurement, penetrated the ground five feet six inches, with heavy snows and hard rains, the mercury dropping to 29° below zero."

THE KANSAS CITY CABLE RAILWAY.

This road will be the first duplicate cable railway built and operated in the world All cable roads that have been built are operated by a single cable, which, if through accident, becomes broken or unsafe, causes a cessation of travel until the damage is repaired. The breaking of cables through carelessness in grip-men unacquainted with exact manipulations of the grip, in Chicago during the first year of its operation, caused many vexatious delays, and until the cable was again repaired travel was entirely stopped. These delays cannot occur with duplicate cables, as there is a duplication of machinery throughout the entire length of the road. One cable remains idle while the other is in motion propelling the cars; if this cable becomes fractured or damaged it is stopped and the other cable is put in motion, which in turn propels the cars, until the damage is repaired or as long as may be desired. The cost too, is very much greater than that of single cable roads.

This road has also another peculiar feature, the westerly portion being an elevated structure built entirely of wrought iron. At or near the Union Depot over Union Avenue an elevated station or waiting-room is to be built, similar in design and construction to to those of the elevated roads in New York City. From

the east side of the waiting-room a continuous span, without intermediate supports, of one hundred and eighty-five feet, is made, which crosses over and above the railway tracks that enter Union Depot. This span is supported at Union Avenue upon wrought iron columns, and the opposite end at Bluff Street upon a stone pier. The summit of the road and bluff is attained at Penn Street 189 feet above Union Avenue, or 166 feet above the track level at waiting-room.

From the centre of the main span mentioned the road begins to ascend the bluff on an inclination of 19 feet in 100 feet for a distance of 753 feet; from this point, which is the west line of Jefferson Street, the road continues on an ascending grade of about 12 feet in 100 feet for a distance of about 300 feet, to the summit of the bluff at Penn Street, 166 feet above the track-level at station referred to. From this street the road descends on an inclination of 11.5 feet in 100 feet, distance 300 feet to the engine house, the external dimension being 90x144 feet. The main floor is 141 feet above track-level at Union Avenue and 57 feet above the next lowest point in road at Main Street.

The basement of engine house is divided into three rooms, the east room as a boiler room, having six steel boilers, and also coal vaults. In the middle room are placed two 250-horse power engines and all the driving machinery, and tension apparatus. The west room will be used as a machine and repair shop. The driving machinery is arranged upon a large cast-iron girder bed-plate with two sets of driving-drums, around which the cables pass in propelling cars, either pair of drums can be put in motion at pleasure by means of a patent screw-clutch, which throws the drums into or out of gear. One pair of drums imparts motion to one cable while the other pair remains idle and the cable motionless.

If the cable in motion becomes damaged by accident, it is immediately stopped and the other drums thrown into gear, thus giving motion to the duplicate table. Another feature not the least interesting is a little stationary engine fixed to the bed-plate of the driving machinery, of sufficient power to move slowly either sets of drums and cables without the additional load of cars gripping the cable. One set of drums being in motion thus, propelling cars on the street, the little engine is put in motion and the other cable not in use moves slowly into the house and is carefully inspected and all defects repaired, at will.

On all other roads this inspection must be done between 12 o'clock midnight and 5 o'clock next morning, as the cables move too rapidly while propelling cars to be inspected, and if inspected during the daytime travel would be stopped. This illustrates the advantage of duplicate cables over the single-cable system.

The main floor of the engine house, on a level with the street grade, is used as storage for cars; the next story as a paint and carpenter shop, etc. In front of the engine house the whole roadway of the street is carried on wrought iron I beams placed proper distances apart for strength and arched between, upon which the paving is placed, there being large vaults beneath the roadway containing machinery pertaining to the road. There are two curves in the road. The changing of cars from one track to the other will be done by gravity, thus dispensing with turn-tables.

The tube will be composed of concrete and cast-iron, there being placed every four feet in length of road of double track, two cast yokes which carry the stringers upon which the rails are laid, and also the slot-rails between the track. These yokes each weigh 300 pounds.

RURAL ENGINEERING.

REV. ALBERT E. WELLS.

But little attention, of late years, has been paid the subjects of the following article, concerning roads, bridges, open drains and water courses. It is true the State Legislature have something to say every session about roads and bridges, and in the interest of sportsmen may enact laws forbidding seining or trapping fish in the smaller rivers and streams.

We hear nothing now of canals, and slack-water navigation, nor is mention made of "the levels" of either streams or roads. The importance of railways, as opening vast areas to settlement and trade, has, for the time being, crowded out of attention the items of use, comfort and beauty, as they might be developed by a careful attention to local needs and facilities. In our want of a way to the great markets, we have slighted the lesser one of a way to the nearest railway station. It is easy to go from there to Chicago, St. Louis, or Kansas Citv, or to send 1,000 tons of freight to any of these markets; but how about reaching the nearest station either in person or with the 1,000 tons of freight from a farm fifteen miles distant? especially during the annual "mud blockade" that besieges nearly every town. In calling attention to these subjects and the problems lying back of them I am near the interests of every one in our western land.

1st. Of present methods. The General Government devotes a great deal of time and valuable franchises and public domain to great railway corporations; but pays no attention to common roads. It also devotes both time and money to navigable rivers and notably to their banks with a view to the well-being of the people living near them. And though under its command is one of the ablest corps of civil engineers in the world, the attention of that corps is not devoted to the set of subjects here mentioned, though they have no small bearing upon those that have hitherto baffled their skill.

The State relegates the subject of roads and bridges to the county authorities, and also that of drains, with some directions about the election of road-masters, and the legal steps for obtaining and paying for a right of way, and the method of constraining the neighbors to work or pay the road-tax, or of compelling an unwilling farmer to grant a ditch across his farm. In some States it is made the duty of the county clerk to keep a record of these road-grants in a separate book, in others these things are passed into the record book.

The county authorities grant the right for a public road on a petition of

citizens resident in the district to be benefitted, who will in the existing order of things have charge of its construction and by tax pay its cost. The authorities say if the people want a road let them have it. So the farmers have such a road as they can make. It would be inconvenient to spoil any one's quarter section, therefore it is rarely a direct road, for the same reason it takes a rough and tumble course over hill and valley along section or quarter-section lines. It is a public road, for the public has consented to its creation. If it become much of thoroughfare, it falls but little short of being a public nuisance, by reason of its heavy grades and want of direction. For instance, it is the route from a town in the northwest of the county to one in the southeast, and traverses two sides of each section in the line. Of streams the county takes no cognizance except to bridge them as cheaply as possible, and regret that the bridging costs so much, and has to be replaced every few years because of a wash-out. So much for the present arrangements. It is expensive, inconvenient, and does not fill the requirements of a good road. The county surveyor has been called on to stake out the road after the "location has been determined." He is the only one connected with the enterprise, whose profession would lead him to know the high order of talent required *to locate a good road.* Dr. Lardner says, "I do not know that I could suggest any one problem to an engineer, which would require a greater exertion of scientific skill and practical knowledge than laying out a road." Our authorities are taking no steps to secure this great skill and knowledge in behalf of the people.

If more were made out of the office of county surveyor, so that that officer should have greater authority in the matter, as the only county officer representing the department of engineering, it might prove a great benefit to the people on the subject of roads. His office should show the position and the profile of every mile of road in the county, and keep statistics from which roads could be classified according to their traffic and expenditures made on them in proportion to their needs.

The necessities of a new country have led to the existing state of things; but it is not necessary to perpetuate it. In behalf of the roads there should be a public officer in every county who should have authority in matters of locating and making roads, and by whom specifications should be made of the cost before it is undertaken as a public charge, even the unit of our population, the road district would obtain a better value for its labor by a competent direction, which now it does not have.

There are some laws on the subjects of rivers, streams, and drains. Of the first and second, these laws have reference for the most part to the preservation of fish, and seem to have emanated from the clubs of sportsmen. While the laws about drains look to compelling owners on the lower level to open ditches across their farms for the passage of the surplus water from the higher level, *i. e.* because A, B and C on the divide have ditched their flat land, D, E and F shall have the best of their land overflowed or crossed by gaping gullies, and the

public shall keep in order three bridges, with from eight to twelve foot spans each, when a competent engineer would say that "there ought not to be a ditch or gully on any farm of the six, nor a bridge to be a public charge on the mile and a half of road that passes along the lower side of the lower farms. The true solution of the problem is the placing of large underground drains that should be the mains of a thorough drainage of the farms in question, and provide also the best economy of land and water, in giving a fish pond, that would yield a harvest of ice every winter to every two of the six.

If it be a larger matter, and an undoubted stream is to be handled so that it may cost as little as possible and yield the best return for the money expended on it, there the civil engineer could render great service. So many items are to be thought of in the consideration of any watershed requiring careful surveys and practical knowledge, that no utility is to be expected from our streams until a different regime comes into force. The friend of man, of which Tennyson and Longfellow sing so beautifully, "The Brook," has within our experience neither use nor beauty.

It may be that a small river is the subject of local anxiety. Its bridges are costly, its annual torrent rarely fails to wash out one or two. Its bottom land is very fertile. Its volume of water varies from what a ten-inch pipe could carry to a bulk that overflows its banks, though the channel has a cross-section of 500 square feet. It is the drain of a large water-shed, what can be done with it? Much, if its whole basin be taken in hand under competent skill; but little if its bare channel is treated. 1st. A great and useful water-power now goes to waste. 2d. A slack-water navigation of from ten to thirty miles is lost. 3d. A supply of water to towns on its banks. 4th. The preventing of overflows, and the sure use of the bottom land, probably the best in the county. 5th. The delivery of its water to the larger river clear of silt. Most of these objects are of local utility. I have not yet named the fish and wild duck that may have their pastime therein and delight the heart of sportsmen. Of this we may be assured, there is enough profit to be derived from every stream, twenty miles long, to pay those living on its borders to have its possibilities examined and developed. And if not cared for, it inflicts an annual damage that equals fifty per cent of what it would cost to put it in order.

If a county have thirty miles of river border, it will be a useful outlay of capital to put it in order; in regard to its channel; in regard to that portion of its basin or water-shed lying within the county, and for the utility of a slack-water navigation and milling power that may be developed.

Of canals I have but little to say. They still have their uses for purposes of irrigation on the high plains of the west, and may serve as a connecting links between different levels, giving length to useful navigation. They are to my purpose now as introducing a quotation from DeWitt Clinton, "Every judicious improvement of roads and bridges increases the value of land, enhances the price of commodities, and augments the public wealth." The road he did the most talking about was the New York & Erie Canal. His statesmanship was

comprehensive, and embraced our subject. I think the subject worthy of the attention of our public men. The subject of roads and bridges does not now receive the attention which its great importance demands. They should not be left to well meaning farmers and citizens who neither have nor desire the scientific knowledge which their proper construction requires and the neglect of the watercourses is an annual cause of waste and damage. A railroad employs five men under a competent engineer for every six miles of road. This engineer has an office and generally a couple of clerks, and is expected to supervise the work on one hundred and fifty miles of road. The county of thirty townships would have about two hundred miles of roads and about three hundred and fifty miles of watercourses. Here is surely enough to employ one man constantly in directing works upon which the comfort, the advantage, the prosperity of so many people depend. If he be allowed a couple of clerks and six men to every township the entire force could be usefully employed. And the importance of the interests involved demand the outlay We are now beyond the early day of our country life, and are entitled to more than the temporary accomodations that were all we could then afford. The state of the country roads is in a measure the indication of our civilization. From their present condition we do not stand high in the scale.

PHYSICS.

THE FIRST ELECTRIC TELEGRAPH.

The idea of the practical application of the electric telegraph to the transmission of messages, says a writer in *Engineering*, was first suggested by an anonymous correspondent of the *Scots Magazine*, in a letter dated Renfrew, February 1, 1753, signed C. M., and entitled "An Expeditious Method of Conveying Intelligence."

After very considerable trouble, Sir David Brewster identified the writer as Charles Morrison, a native of Greenock, who was bred a surgeon, and experimented so largely in science that he was regarded in Renfrew as a wizard, and eventually found it convenient to leave that town and settle in Virginia, where he died. Mr. Morrison sent an account of his experiments to Sir Hans Sloane, the President of the Royal Society, in addition to publishing them anonymously, as stated above.

The letter set forth a scheme by which a number of wires, equal to the letters of the alphabet, should be extended horizontally, parallel to one another, and about one inch apart, between two places. At every twenty yards they were to be carried on glass supports, and at each end they were to project six inches beyond the last support, and have sufficient strength and elasticity to

recover their situation after having been brought into contact with an electric gun-barrel placed at right angles to their length, about an inch below them. Close by the last supporting glass a ball was to be suspended from each wire, and at about a sixth or an eighth of an inch below the balls the letters of the alphabet were to be placed on bits of paper, or any substance light enough to rise to the electrified ball, and so continued that each might resume its proper place when dropped. With an apparatus thus constructed the conversation with the distant end of the wires was carried on by depressing successively the ends of the wires corresponding to the letters of the words, until they made contact with the electric gun-barrel, when immediately the same characters would rise to the electrified balls at the far station. Another method consisted in the substitution of bells in place of the letters; these were sounded by the electric spark breaking against them. According to another plan the wires could be kept constantly charged and the signals sent by discharging them. Mr. Morrison's experiments did not extend over circuits longer than forty yards, but he had every confidence that the range of action could be greatly lengthened if due care were given to the insulation of the wires.—*Electrical Review.*

LIFE ON THE PLANETS.

Prof. McFarland, of the Ohio State University, in the *Sidereal Messenger*, says: Thirty years ago the question of the habitability of the planets was widely and, in some instances, intemperately discussed. Several volumes were written pro and con, the writers mostly seeming to think that they had a direct commission from on high to settle the question or to settle their opponents; which things they proceeded then and there to do. And both sides about equally forgot or disregarded the facts, and with great heat argued on general principles.

An article in the June number of the *Popular Science Monthly*, entitled "The Cost of Life," and which was in part criticized in a late number of the *Messenger*, is a kind of renewal of the useless debate, and is clothed in logic equally conclusive as was that of the original controversy. The points given lately touching the weight of a man on Jupiter and Mars were intended as a part of the proof that these planets are not habitable. To pass in review all the points of error would require an article of too great length for the pages of this journal; so I shall confine myself pretty closely to a few of the more prominent ones.

The same author, speaking of Mercury, says: "With a temperature of boiling water in the frigid zones, and red-hot iron at the equator," etc.—therefore there can be no life on the planet. But there is no proof of any such temperature, and in the nature of the case there can be none. Wherefore the conclusions are of no force. The error consists in virtually assuming that the climate of a place depends solely on its distance from the Sun—whereas this is only one of a hundred causes.

It is well known that even in the Torrid Zone at an elevation of about three

and one-half miles, snow does not melt; that century after century "eternal" snow whitens lofty peaks in all latitudes.

The temperature of a place on the earth's surface depends on many influences, any one or several of which may be greatly modified or annulled by the others; so that there is no general rule for climate.

As a part of the multitude of things to be taken into consideration as touching the matter in hand, we may name these, viz: The latitude, the elevation above the sea-level, the ocean currents, the direction of the prevailing winds, the presence and trend of mountain ranges, the amount of vapor usual in the atmosphere, the degree of cloudiness, the quantity of rain and snow-fall, the size of the body of land, the amount of land in close proximity and its surroundings, the nature of the soil, the amount and kind of vegetation, the density and height of the atmosphere, the length of the day, the obliquity of the Sun's rays, and the thousand and and one other things which go to make up the whole temperature and climate. Of the greater part of these—indeed, of almost every one of them—as exhibited on other planets, it is absolutely impossible to know anything at all, and as a matter of course, no one can speak intelligently of the climate on any planet except our own. But should all these items be known, the further question arises whether it is not possible that animated beings could live in an environment totally unlike that which surrounds us. The conclusion of the whole matter, so far as astronomy and physics can now tell, is this: That the four large outer planets have not sufficiently cooled down to allow life on their surface, such as we see on the earth; that Mars gives all telescopic and spectroscopic probabilities of conditions compatible with life as we see it; that the earth certainly for millions of years has been covered with multifarious life; that of Venus and Mercury we have no certain knowledge; and that the satellites are pretty certainly not fitted for such life as is on the earth; that, in particular, our Moon has no water and no atmosphere, consequently no climate or vegetable life. If the Sun and the planets continually lose heat, then there will come a time in the far future when the Sun itself shall go out in everlasting night, and the planets cool down so that the "eternal snow" would be hot compared with the degree of cold throughout all space where everything shall be dead.

SOUND VIBRATIONS PHOTOGRAPHED.

Photography appears to be running a race with electricity in curious developments and novel applications. George G. Rockwood, the well-known photographer, has just achieved the remarkable feat of photographing sound-waves instantaneously. The instrument by which the sound-wave was represented or made visible in its effect is a new telephone, the inventor of which has obtained from Mr. Rockwood a perfect ocular demonstration of its vocal repeating action. The vibrating diaphragm, upon which the voice is projected, has a fine metallic point mounted on the center of its reverse side. This point meets the pointed

end of a conducting wire so nearly that when at rest the interval between the two points can be discovered only through a strong lens. The thing to be done was to show in a picture of the instrument, or rather in a series of pictures, the alternate contact and separation of the points from the vibrations imparted to the diaphragm by the voice, involving the closing and opening of the electrical circuit and the consequent reproduction of the same rate of vibration in the receiving instrument at the other end of the line. In considering this problem Mr. Rockwood found himself indebted to his recollection of an experiment by Herschel in photographing (or daguerreotyping) with the electric spark. Herschel caused a four-sided prism of wood, around which a picture was pasted, to revolve at high rate of speed as in a turning lathe. By illuminating this revolving picture with the electric spark (in total darkness otherwise) he obtained a photograph of it as standing still at that instant in its revolution when the spark flashed. In describing his experiment Mr. Rockwood said:

"Wheatstone measured the duration of the electric spark as one-twenty-four thousandth of a second. It would follow that any vibration not quicker than this might be arrested on the photographic plate at any point in its travel. Whereas, according to the investigations of Plateau, the duration of successive impressions on the human eye will average half a second, the electric spark might separate and distinguish photographically waves of which 12 000 impinge on the retina while the first of them is still lingering there; in other words, 12,000 practically all at once. Now the vibrations or waves of air that yield the respective tones or pitches of sound have been accurately measured and counted. Assuming the pitch of the ordinary masculine voice in conversation to be as low as middle C, the number of complete double vibrations imparted by such a voice to the telephonic diaphragm or tympanum would be 256 per second; that is, counting both ways, 512 movements of the diaphragm with its metallic point making or breaking the electrical circuit at each movement. To the eye, which retains every impression for half a second, 256 of these movements would make their impression as one, and would give a stationary, fictitious image, if they were of sufficient depth to produce any visible effect whatever, as they are not. The electric spark, however, would give its illumination and do its photographic work within a little more than one-fiftieth of the time of one of the tympanum movements. A succession of such photographs, therefore, would present fortuitously any position of the vibrating point from that of contact to that of extreme retraction, with an indefinite number of intermediate positions."

To verify these calculations, Mr. Rockwood carefully focused his photographic camera on the points of the telephone by daylight, and a battery of Leyden jars was so adjusted that when discharged it would throw the proper illumination on the points. Mr. Rockwood's instantaneous plates were now to be tested under action five hundred times quicker than a sensible instant and also invisibly minute. Of course it was as yet a practical question whether they could effectively receive as quickly as the electric spark would give this infinitesimal action of light. Waiting until the darkest hour of the night, the plate was un-

covered in total darkness, the telephonist began speaking into his instrument, and the illuminating spark was flashed upon the points. This operation was repeated with more than twenty plates in succession. The resulting negatives, on being developed, proved a triumph in two arts and a science. The photographs printed from them showed under the glass, in some, contact of the points, and in others a variety of infinitesimally differenced intervals between them. Not one of the impressions had more than the one-twenty-four thousandth of a second in which to be begun and ended.—*Electrical Review.*

CHEMISTRY AND METALLURGY.

THE SMOKE NUISANCE.

PROF. R. S. G. PATON.

In walking in and around Kansas City I have noticed a considerable amount of smoke emanating from the chimneys of a number of manufacturing establishments. This is by no means necessary, and should be checked at once, especially in such a growing city, as the evil will in nowise become less on the increase of the number of chimneys. Smoke is deleterious to the health of a community and, besides, it is extravagance on the part of the manufacturers to allow of its emission.

Whilst chemist of the Health Department of Chicago, I was given charge of the enforcement of the "Smoke Ordinance," and the following is some of the results of my work.

This ordinance came into effect on the 1st of May, 1881, and I had the honor to be appointed to carry out its provisions on the 1st of July of the same year. From that date until the 16th of July, 1882, I acted alone; since then I have had either one or two assistants.

The number of persons or firms called upon	654
The number of visits made	1821
The number of locomotives observed smoking . . .	94
The number of steam tugs observed smoking . . .	239
The number of elevators observed smoking	18
The number of special trips on locomotives	3
The number of special trips on tugs	2
The number of visits examining devices	63
The number of abatements observed	219
The number of devices for suppression of the nuisance examined	49
The number of suits commenced	111

Of these 52 were fined, 16 took change of venue, and 43 were dismissed.

Number of cases in quasi-criminal court 7

Amount of fines imposed in police court . . . $2,045 00

Of that $35 were on change of venue cases.

Amount of fine in quasi-criminal court . . . 5 00

Considerable trouble has been gone to in order to persuade the various railroad companies to obey the ordinance, and I am glad to be able to report that some have made endeavors to do so.

With regard to the steam tugs, I have to report that some of the owners—for the benefit of all the owners—have tried various experiments in order to comply with the law. They are at present corresponding with boiler-setters, furnace-builders and patentees of smoke-preventing devices. The number of steam tugs mentioned above represents those of which definite data are preserved.

With regard to the trials for refusal to comply with the smoke ordinance, they represent much more work than might at first be imagined. In the first place dense smoke must be observed coming from a certain chimney stack; the officer then serves a notice, verbal or written, on the owner, occupant or proprietor of the building, preferably the latter. If, within a given space of time, say ten days or two weeks, he finds that no attempt has been made toward abating the nuisance, he must apply to a justice of the peace for a summons against the offender, and see that it is properly served and returned. Then the inspector must procure witnesses who will testify that the smoke from that particular chimney stack is to them a nuisance. This in many instances is an exceedingly difficult task. It is, however, very easy if the officer commences work at the instigation of a written complaint from some of the neighbors. When the day of trial arrives it is necessary to see that all the witnesses, attorney, etc., are in place, prepared. If the defendant requests a continuance, or a change of venue, or, being fined, takes an appeal, this whole matter, except in regard to the summons, has to be repeated. As it was very rarely that the case was concluded on the first call, the appearances in court may be calculated as not less than about three hundred and fifty (350).

The only case which was tried in the quasi-criminal court was that of the City of Chicago vs. James S. Kirk & Co., soap manufacturers, which, I am happy to report, ended, after a severe fight, in favor of the plaintiff.

Upon the whole I have to report that the citizens as a rule have shown a very commendable desire to abate the smoke nuisance, and a very considerable amount of work has to be done in that direction. The extent to which this effort has been carried cannot readily be determined, but the condition of the atmosphere in the central business portion of the Southern Division of the city at the present day speaks for itself when compared with that of eighteen months ago.

Chemically speaking, smoke is composed of carbon, carbon monoxide (commonly called carbonic oxide), carbon dioxide (generally named carbonic acid),

sulphur, sulphurous and sulphuric oxides, carbon disulphide, sulphuretted hydrogen (rarely), ammonium sulphide and carbonate, water, large quantities of nitrogen (from the atmosphere supplied below the grate), and, when thrown off from certain works, may contain hydrochloric, nitrous and nitric acids, or even metallic and arsenical fumes.

The question as to whether these products can be considered a nuisance or not, has already been, in my opinion sufficiently decided in the affirmative by eminent legal authority. Permit me to draw attention to their chemical and physiological properties.

Carbon. Dr. Knauff (Virchow's Archiv., band 39, p. 442,) confined animals in a box into which the particles of a sooty lamp passed; the animals were well fed and were healthy; the charcoal passed into the lungs, and was got rid of by expectoration in the form of pigment cells. In a cat, charcoal particles penetrated in three days from the lungs into the lymphatic glands and to the pleura. Villaret confined rabbits in a smoky atmosphere, and proved the existence of fine particles of carbon in the bronchi. These fine particles of carbon may, therefore, enter the lungs and remain there as sources of great irritation until dislodged, or become covered with epithelium, like the carbon in the lungs of the miner (miners' phthisis). There is also the objection to the mechanical obstruction of the external pores of the body.

Carbon monoxide, sulphurous oxide, and nitrous oxide are strong deoxidizers, abstracting oxygen from the softer tissues, and when absorbed into, from the blood. They may, therefore, be ranked as distinctively poisonous, the first being said to be diffusible through the pores of cast iron, and are all the products of incomplete combustion. Some carbon monoxide is given off even during complete combustion, though not nearly in the same quantity as under disadvantageous circumstances. It likewise affects health by forming in the blood a new and fixed deleterious compound with the hæmaglobin.

Carbon dioxide—one of the principal products of the complete combustion of ordinary fuel—is very readily dispersed throughout the atmosphere by means of the rapidly moving currents of air and the laws of the diffusion of gases. Again, it is one indispensable factor in the food of plants, and, being very soluble in water, is speedily carried into the soil by the action of rain or dew. Carbon dioxide, when exceeding five parts in 10,000 parts of atmospheric air, is objectionable. It cannot be said to be poisonous, but is asphyxiating by replacing a portion of, or reducing the percentage of, the oxygen which should be present. Woodman and Tidy, however, claim that it is poisonous, and then state that "air contains ordinarily from 3 to 6 parts of carbontc acid in 10,000. * * * * The air expired (in a room) contains from 4 to 5 *per cent* of carbonic acid. If the same to air be again respired, the additional quantity of carbonic acid expelled at each inspiration would gradually lessen until a total was reached of *10 to 12 per cent*, and then no more carbonic acid would be given off. An atmosphere under such circumstances must prove fatal."

This last statement must undoubtedly prove true, but such circumstances

we can never expect in the atmosphere of a city; therefore, when speaking of smoke, I must abide by my previous statement, acknowledging that in some parts of a city we may have sufficient quantity, which, breathed for a length of time, would produce drowsiness and a gradual loss of muscular power.

The amount of sulphur and its various compounds thrown into the amosphere during combustion depends entirely upon the nature of the fuel used. These sulphur compounds do not seem to be very readily removed by diffusion throughout the air, although Oesterlen states that sulphuretted hydrogen, ammonium sulphide, nitrogen, carbon dioxide and carburetted hydrogen will pass easily through walls of cess-pools. Their actions upon the health have been very variously described.

The fumes of metals, such as antimony from type works, as also fumes of arsenical compounds from copper works, are, as all know, extremely dangerous to health.

The question now arises, "Can the smoke nuisance be abated?" Undoubtedly it can, at least to the extent that the Chicago ordinance has demanded. Well, how? Attempts have been made in this direction since the year 1785. At first the idea was rather the saving of fuel than the prevention of smoke. By the ordinary combustion of one U. S. ton of soft coal above 22 (22.32) pounds of soot are thrown off into the air. This is a matter of great expense, carbon (soot) being the chief heating substance of the coal. One pound of coal requires from 150 to 250 cubic feet of air to insure complete combustion. How is this object to be obtained? First, by having a furnace of suitable dimensions—height, width and length—with the proper area of air space between the fire bars. This last is regulated by the kind of fuel to be used—narrow interstices for wood, wide for hard coal. The width and length of the furnace are regulated by the dimensions of the boiler, whilst the height depends upon the amount of fuel required. Here, you will permit me to say, that my opinion is that there should be a very large space between the top of the fire bars and the bottom of the boiler. I have found in some instances in this city the coal actually in direct contact with the bottom of the boiler. Need I say that the chimneys connected therewith emitted dense volumes of smoke? The size of the furnace will also determine the dimensions of the doors. Firing should not be had recourse to very frequently because of the influx of large quantities of cold air every time the doors are opened, chilling the contents of the fire-box and the sides of the boiler. Smoke will be emitted either when there is too great or too small an amount of air supplied. An ordinary kerosene lamp very readily demonstrates this—turn up the wick too high, the result is smoke, (too little air for amount of kerosene): the wick being at the proper height, place the lamp in a draught, the result is the same, but for the converse reason—too much air. It would be well if some of our so-called engineers would sit down and study the workings of a common kitchen stove for a day or so. I say "so-called engineers" because, I regret to say, I have found a good many men in charge of boiler-rooms in Chicago who could not even be ranked as good firemen.

The size or dimensions of flues, breeching, and chimneys, must coincide with the conditions and regulations of the furnace.

In firing, my preference is toward that method known as the coking process, *i. e.*, pushing toward the rear of the firebars the already "live" coals, and placing the green coals in front, so that the gases arising from them in coking may be consumed in passing over the incandescent fuel. In this opinion I am upheld by many authorities.

When fresh coal is placed in a bright boiler furnace various hydrocarbons are given off. In coming in contact with the oxygen of the atmosphere, at the proper temperature, they are converted into water and free carbon—the hydrogen uniting with the oxygen at a lower temperature than does the carbon. This latter becoming united with a further quantity of oxygen is then converted into carbon dioxide. The carbon dioxide, passing on toward the rear of the furnace, meets with red hot carbon and becomes carbon monoxide. Some of it, however, passes on to the chimney without alteration. The carbon monoxide, if supplied with still more oxygen, will be reconverted into carbon dioxide, though this, as before stated, is never completely accomplished. The difference, then, between complete and incomplete combustion is, that in the former, no carbon (soot) and very little carbon monoxide are produced; whilst in the latter case carbon (soot) and much carbon monoxide are given off.

DEVICES FOR ABATING THE NUISANCE.—Their name is legion. Permit me, however, to enumerate some of the principles on which they are founded:

1st. Automatic firing. This is an excellent principle.

2d. Alternate firing; also considered very suitable. It consists in having two separate furnaces and sets of firebars, etc. A is fired and the gases compelled to pass over or through the incandescent fuel in B, and *vice versa*.

3d. Sloping bars, either toward the front or rear, or laterally upward or downward, considered favorably by those who prefer the coking method of firing.

4th. Movable firebars. These may be either on the principle of an endless chain or of a rotary fire-grate. Liability to get out of repair and expense in the matter of fuel militate against them.

5th. The coking principle, already spoken of.

6th. Washing the products. This gets rid of the nuisance so far as the mechanical objections are concerned, and some, though not all, of the chemical. It has, however, been entirely discarded in Europe.

7th. High chimneys have been recommended by some, but in my opinion have not fulfilled what was promised for them.

8th. Air currents. There is a great variety of these, both hot and cold, from front impinging on the flame, laterally also on the flame, laterally through the bridge-wall, and from the rear through the bridge-wall. Some are introduced by means of steam-jets, whilst some are passed in dry by means of the natural draughts.

9th. Deflectors. These are brick or metal projections from beneath the

boiler, in front and in rear of the ordinary bridge-wall. They have been of considerable value on locomotive boilers, though some claim they are liable to warp some of the boiler plates. My own knowledge does not agree with this opinion.

10th. Doors. These are sometimes perforated, slit or hanging, and seem to be of advantage in some cases, admitting air into the fire-box itself, as do all the air-jets, wet or dry.

11th. Mixed Devices. These are compilations of ideas taken from two or more of the above designs. They are rarely worked upon by men who have inventive genius.

12th. Petroleum Jets. These have been tried in several places, but, so far as I am aware, with but poor success. Steam has to be raised in the boilers before they can be applied.

13th. Smoke Burners. These are devices which return the smoke underneath the fire bars. I am not particularly impressed with them, as I believe them to be valueless.

14th. Boiler Setting. This, as been said before, is a great item for consideration under this subject, and may be spoken of as devices built for economy of fuel by giving a very large space for the perfect intermingling of the gases of the coal and of the atmosphere.

In conclusion I wish to state that the matter of smoke prevention is by no means yet thoroughly grasped, but may soon be if we obtain, along with the above considerations a matter which I thus expressed to the Engineers, "Intelligence in front of our boilers."

Permit me quote here a statement made by Wagner, with which I thoroughly coincide, as it bears out the remarks I have but poorly made above: "As regards smoke consuming and smoke preventing apparatus, it is only too evident that most of these do not answer the purpose so completely as might be expected. Practical experience has, however, taught that if the conditions of complete combustion are well attended to in construction of the furnace, with proper management and regular mode of stoking, adequate supply of air, and the application of the well-known means of preventing loss of heat by radiation, with coal, peat, or any other fuel, the combustion may be conducted so as to be smokeless; and at the same time the fuel thoroughly utilized."

MEDICAL DEPARTMENT OF KANSAS CITY UNIVERSITY,
CHEMICAL LABORATORY, NOV. 13, 1883.

THE PHILOSOPHY OF FLUXES.

The rationale of fluxing brings us face to face with a wide-spread popular fallacy that has remained undisturbed and unrefuted (so far as we know) by any of our teachers of modern science. Workmen generally believe that by adding what is called a flux to a melted or melting metal, the metal is made to melt at a lower temperature, or that being melted, the flux renders the metal more fluid.

If this were really the case, it would be a very remarkable fact, well worthy of scientific investigation. It would disturb all our tables of fusing points and the prevailing scientific doctrines of the relations between the solid and liquid states of matter.

SOLDERING FLUXES.—Let us first consider the familiar cases of soldering fluxes. For soft soldering we may use rosin or ammonium chloride (sal ammoniac) or hydrochloric acid (spirits of salt). What happens in such cases? The tin-man, for example, places a stock of solder and alloy of tin and lead on his work and applies the soldering-iron. If no flux is used the solder melted off from the stick forms a little ball which stands sluggishly on the tin plate and is ineffectual. If on the other hand, a little powdered rosin is there when the soldering-iron is applied the melted solder "runs," spreads itself with decided fluidity over the surface to which the rosin has been applied. The solder flows, and hence the rosin is fairly regarded as a flux.

Take another case. Two pieces of brass, fitted or pressed together with considerable surface of contact, are to be united by soldering. If these are placed in the fire, bound together, and heated to no matter what temperature, and a piece of soft solder be applied at the boundaries of the surfaces in contact no solder will run between these surfaces. If, however, a solution of sal ammoniac, or hydrochloric acid, or chloride of zinc, be dropped or brushed against the edges of the joints just when the metal is about the heat of boiling water, and this liquid be thus made to run into the joints, a great difference is made. The workman now has only to carefully heat the metal to a certain temperature (presently to be defined) when he finds that on application of the stick of solder it not only melts, but spreads or runs rapidly over the surface that was moistened by the flux; and if the operation were skillfully performed it insinuates itself with the fluidity of water between the joints, however close-fitting they may be. The fluidity thus imparted is even more decided than in the first case.

HARD SOLDERING,—Whether silver soldering, or brazing, is performed in a similar manner, excepting that the silver or the "spelter" (a fusible brass) is applied in granules mixed with the flux in a state of powder, the flux in these cases being borax.

The writer has had considerable experience in both hard and soft soldering of brass work, and after some reflection has framed the following theory: He is quite satisfied that these fluxes have no effect on the meeting point of the solder, nor even any direct effect on its fluidity when melted, and believes that their whole efficiency depends on their power of presenting to the melted solder a pure metallic surface, to which it can adhere, or in fact alloy itself more or less completely. We know that melted tin, or lead, or zinc will thus adhere and alloy themselves to clean surfaces of other metals, just as mercury will amalgamate with certain metals. If a piece of dirty brass or copper be dipped into a bath of tin or lead, or the solder alloy of these, it will come out unaltered; but if it be very carefully cleaned it will be "tinned" all over by them. The tinning and the galvanizing of iron plate further illustrates this.

How, then, do the above-named fluxes act? Let us consider the rosin first. This is a hydrocarbon, a powerful reducing agent, and which, when heated, combines with the oxygen of such metallic oxides as those of tin, and thus effects a reduction of the pure metal on the surface to which applied. Thus the tinman deoxidizes his tin plate surface, and then his solder amalgamates or alloys itself freely with and runs over or "wets" it. We take the liberty of using this term "wets" on account of its analogy with the familiar action of water which adheres to some surfaces or wets them, but runs off of others, such as greasy or dusty surfaces. This difference corresponds to the action of the solder with and without the flux.

But what is the action of the ammonium chloride? Careful observation enables us to answer this question. After applying the solution, the water dissolving the salt boils off, and there is left behind a white coating of the salt itself. Then we go on applying more heat, and if we are skillful, we watch this white frost, and when we see it begins to dissipate by volatilizing in white fumes, we apply the solder before the last of it has gone. Then the solder runs, but if we had applied it sooner or later we should have failed. In this case we believe that the ammoniacal salt dissolves the tin film of oxide and forms a compound which, like all other compounds of ammonia, is volatile at a certain temperature. Now in this case the temperature of volatilization of the flux corresponds to the melting point of the solder, and hence their adaptation to each other.

As our practical readers know, especially the old hands, the use of sal ammoniac is now rather old-fashioned, having been nearly superseded by solutions of zinc in hydrochloric acid, or of the acid itself. The action of these is the same as above described, but more decided and demonstrable, just as they are more efficacious. The hydrochloric acid dissolves the oxide, and the chloride thus formed is a volatile salt, especially the chloride of zinc.

In our apprentice days, when we received our first lesson in soldering together the segments of a "staff-head" before turning it in the lathe, we were told to watch the brass until it became "beefy," and then apply the solder. What was this beefyness? We have tested this question experimentally, and find that it is due to a removal of superficial film of zinc from the brass, thus exposing a red or coppery surface, to which the term "beefy" may be fairly applied when it is hot and free from oxide. The zinc in the brass oxidizes more readily than the copper, the zinc oxide is more readily soluble in hydrochloric acid or chlorides, and zinc oxide and its salts are more volatile than those of copper. Hence the preferential removal of the zinc and exposure of the beefy copper.

The same beefyness is displayed in hard soldering, and may be seen even after the soldering is completed and the work has cooled, if some portion of the brass surface that was denuded by the flux was not covered by the brass solder. Brass tubes frequently show this.

But why is borax used rather than chlorides, and how does it act? To answer this question we must consider the chemical properties of borax. It is a

compound of boracic acid and soda, resembling water glass, which is a compound of silicic acid and soda. Both of these when heated with metallic oxides form glassy compounds. Blow-pipe analysis largely consists of fusing metallic oxides with borax or boracic acid, thus obtaining a glass bead in which the oxide is dissolved, the color and other appearances of such bead indicating the presence of the particular oxide. When powdered borax is laid over the metal to be soldered, and the metal is heated, the borax fuses, forms a glassy film upon the surface of the metal, which film takes up all the oxide and combines with it, forming a glassy borate of the metal. But this is not sufficient, for if that glassy film remained it would be as bad as the oxide in preventing the adhesion or amalgamation of the solder. Here then comes to our aid another property of the borates, viz., their volatility at high temperatures. The borax, with the oxide it has taken up flies off at a bright red heat, just at the temperature at which the granules of the silver or the spelter brass melt. Thus they fuse upon a virgin surface of clean metal and unite with it.

We have thus gone a little aside from our direct subject on account of the confusion that the use of this term "flux" may induce. Borax is also used as a flux in metallurgical operations where a metal, such as gold, mixed with impurities is melted. These impunities are taken up by the borax, made into a fusible glass, and thus fluxed or melted away. It is not the gold which is made more fluid, but the oxides of the baser metals that have to be removed.

The fluxing in the blast furnace is similar to this. Its action is not the liquefaction of the iron itself, but the gathering together of the impurities of the ore, converting them into a glass that shall fuse and run down with the melted metal, for we must always remember that the fundamental problem of the modern blast furnace is that everything pitched into its throat must come out either as a gas or a liquid. The retention or formation of any infusible solid would choke or "gobi" the furnace and put an end to its profitable operation.

Silicic and boracic acid are the two chief glass-making agents, the boracic glasses fusing at lower temperatures than the corresponding silicic glasses, and also being more volatile. But we may now dismiss these, and confine our attention to the silicates, and they do the fluxing in the blast furnace. This statement may appear paradoxical for the moment, seeing that not silica, but lime, is the so-called flux of the blast furnace charge. This is easily explained by reference to the analysis of the clay ironstone ores already given. They all contain silica; in some cases partly free as sandy matter, or combined with alumina, or combined with the iron itself.

Silicate of alumina alone is objectionable, on account of its high fusing point. Silicate of iron fuses readily enough, but it is a thief, as it carries away as useless glass the material we are seeking to obtain as reguline metal. We, therefore, require to add something that is more powerfully basic than the iron or its oxides, which will therefore combine more readily with the silica, and this should form a glass that is readily fusible and which will somehow separate itself from the melted iron. Cheapness is another primary desideratum.

All of the desiderata are united in lime. It is a powerful base, it is very abundant and cheap; its glass is much more fusible than iron, and is also so much lighter that it floats freely on top of the melted iron, and thus may be run off through an overflow conduit or tap hole. Lime, therefore, is used, but it must not be used at random for the following reasons: If the supply of lime is not sufficient to combine with the silica, this will unite with the oxide of iron and form a wasteful iron glass, or its silicon will remain excessively in combination with the iron itself. If, on the other hand, the lime is in excess, we may get into trouble, due to the fact that uncombined lime is a most refractory substance, practically infusible, as proved by its use in the lime-light where a mixture of oxygen and hydrogen gases in vivid combustion strikes against a cylinder of lime, making it so intensely white-hot that the light it emits is the most brilliant obtainable. This oxy-hydrogen is hotter than any furnace yet constructed.

CINDER OR SLAG.—This explanation of the rationale of fluxing in the blast furnace explains also the composition of the cinder (so often misnamed "slag," as we shall explain hereafter), which carries away everything excepting the pig iron and the gases. It is mainly a lime glass, and, being a glass, a multitude of schemes have been devised and patented for using it as a material for bottles and for other purposes to which glass is applied. The inventors have not sufficiently considered the fact that lime glass is much more iriable than lead glass, or soda glass, or potash glass, or the mixtures of these that form the material for our windows, bottles, etc.

The problem of utilizing this mixture of silicates in which silicate of lime variably preponderates is not yet solved, on a scale commensurate with the supply of the material. It still remains a worse than worthless waste product, as its disposal is costly, partly on account of its bulk and weight in carriage, and partly on account of the ground it covers and renders useless. Of all waste products of British manufactures this one is about the most unmanageable.—*Iron.*

ARCHÆOLOGY.

THE LAKE DWELLERS OF VENEZUELA.

In many parts of the world, particularly In Europe, there are remains of the structures of an ancient people known as Lake Dwellers, from the fact that they lived in houses built over the water. In that beautiful sheet of water in Switzerland, Lake Geneva, there are such remains, but there are savage tribes in Oceanica who illustrate the ancient practice to-day, dwelling in huts built upon poles, at a considerable distance from land. In America the only instance of this mode of house building is found in the lake of Maracaibo, which lies in the north of Venezuela. Whether or not this habit of living suspended above the water is

indicative of special characteristics, in which fear of enemies is the chief element, we are not ready to say, but it seems altogether likely that such is the case, as the tribes who live in this isolated fashion are generally distinguished by a peaceable or non-warlike disposition.

In regard to the Maracaibo Indians, who are believed to be an offshoot from the Venezuela Indians, this is true, as it is related that many years ago a violent war arose among the Indians of Venezuela, and the conquered were driven out. Taking to their boats, they sailed away for the purpose of seeking a new region in which they might dwell.

This lake, which is about one hundred miles in length and sixty wide, is connected with the Gulf of Venezuela by a strait twenty-five miles long. The conquered Indians had purposed to pass through the strait on their way in search of a new country, but a violent storm came up, and compelled them to mass their boats closely, and tie them together with bamboo poles for protection. This maneuver enabled them to meet the storm successfully, and it suggested the idea of their building pile houses over the lake, which would be safe from fire and flood, and give them security against their enemies. They proceeded to carry out the idea, and ere long a village of bamboo houses sprang up, as it were, out of the water. Strong poles driven firmly into the bottom of the lake, and secured at the top by cross-pieces, constitute the foundation on which their houses are built. The roofs are formed of a framing of bamboo, arched as in the illustrations, and neatly thached.

For sleeping purposes they use hammocks. The hygienic conveniences of these houses are superior; ventilation and drainage are matters of nature's own provision, and cases of pulmonary disorders are unknown. These houses are built near enough together for access between them by means of short foot-bridges.

Living, as these people do, directly over the water, they subsist largely by fishing. They also make many articles of bamboo, and gather shells on the beach, and fruit on the neighboring land, which they sell in the city markets of Maracaibo. It is said that they have a stronger disposition to industry than the natives of Venezuela further inland. But this may be due to their mode of living and in being compelled to exert themselves to obtain the necessaries of life. —*Phrenological Journal.*

RELICS OF AN EXTINCT RACE NEAR SANTA BARBARA.

About two or three months ago C. W. Clark, of this city, decided upon collecting a small cabinet of curiosities, to include coins, relics and trinkets. The result has been the accumulation of a store of rare curiosities which would make an ordinary natural history society turn green with envy. The last important addition is a collection of stone utensils manufactured by a race of people now

extinct upon this coast, who were evidently far advanced in the science of stone-cutting, and also in the arts culinary and ornamental. The Digger Indians were not the first inhabitants of this region. There was a race of people living here in Santa Barbara, more industrious and better informed as to how life and comfort might be prolonged and promoted than the poor, groveling, subservient race of "root-diggers" found here when the Dominican padres came here to plant and cultivate civilization. Most of the houses of the old residents of Santa Barbara's sea coast contain queer and well-finished articles of stone-ware dug up or found upon the surface of the earth, all relics of a people now extinct.

These articles are nearly all of stone. Some, however, are of bone and fibrous formation, and none of metal or wood. The archæologists have for years been digging up and investigating the formation of the mounds in Iowa, Indiana, Illinois, and Missouri. They have dug up and sent east shiploads of arrowheads of flint and spearheads, war-clubs and trinkets of a crude and rough shape. Pieces of pottery have been collected in Colorado, New Mexico and Arizona, all showing that civilization once existed upon this continent prior to the arrival of the now fast disappearing Indian race. We had a very industrious and intelligent race of people living upon this coast in the long, long ago. Who were they? Vancouver, the famous navigator, says in his description of this coast more than a century ago, that there were no less than thirteen populous villages of natives upon the sea-coast now known as Ventura and Santa Barbara. Where are those thirteen populous villages? Where are the native descendants? All that can be found concerning them are the fragments picked up in the valleys or the relics dug from the graves. The Indian graves of this section and the adjacent islands are prolific in specimens of the handiwork of an extinct population. These specimens that are exhumed, and of which the Smithsonian Institution, at Washington, contains many tons, are indications of industry practiced here two or three centuries ago, which puts all of our fine stone-cutting and sculpturing in the shade. These extinct tribes made piping or tubes out of the hard agate rock, beads out of shells, charms and talismans of exquisite shape and perfection, representing fishes and animals, out of abalone shells; fine fish hooks from mussel shells, and all kinds of cooking utensils from the solid rock. They had no metallic chisels or drills, no metals of any kind, no turning lathes, and yet their work is perfect.

The collection donated October 14th, to Clark's Natural Museum, includes one mammoth-sized mortar and pestle, both cut out of solid hard rock, the mortar nearly two feet across the top, the pestle two feet in length. Both are perfect in contour and finished as smoothly as rock can be dressed. The mortar would hold about half a bushel of grain and was no doubt the property of the miller of the tribe, who could grind corn meal very rapidly by the aid of such a large-sized hand-mill. Then there are a dozen or more beautifully finished mortars and pestles, all of solid stone, some of one variety of stone and some of another. Some of the mortars are of smoothly polished agate and very beautiful. The most remarkable of these exhumed Indian curiosities are the ollas or water ves-

sels and the solid stone cooking vessels. These latter articles are wonderful. The largest is a globular vessel of solid stone chipped out of the hardest kind of rock and as round as a ball. It is hollow and has been patiently chipped out until the globe is quite hollow, about two inches thick, with an aperture about four inches in diameter at the top. It still bears the marks of fire, although it has been buried, perhaps, two centuries. There are several of these globular stone cooking vessels in Clark's collection and dozens of other aboriginal curiosities.

Dentistry seems to have been quite an art in the days when the extinct race held control here. Among the store of curiosities exhumed from the graves upon the Santa Barbara Islands and now in Clark's collection are six or seven set of false teeth. They are formed each from a shell which was fashioned to fit the roof of the mouth or could be adjusted outside of the gums. These shell teeth are perfectly formed and easily adjustable. Whether they were used for ornament or for mastication of food is one of those mysteries the grave still holds in concealment. The water bottles are round and are of woven glass mixed with asphaltum. The pipes are tubes of agate or fine colored stones gathered upon the beach. How the natives turned and polished this hard flint-like stone and then drilled holes through it so as to use it for a pipe is a mystery. Among these recently exhumed curiosties from the Santa Barbara Islands are dozens of highly polished stone rings; some of them have been broken, but have been mended with cement of which asphaltum is the principal ingredient. This cement used by these extinct tribes appears to have been durable and effective, as the shattered stone rings united by it are as strong and as solid as those not damaged.

The islanders appear to have made good use of seal's teeth and whalebone. The latter, when found in a petrified state, was used as our Chinese abalone gatherers use an iron bar—to pry up the mollusks from the rocks. Mr. Clark has one of these petrified bone crowbars, one side of which was used as a creator of fire. Its rough side resembles a file, and the rapid friction between it and a piece of dry wood creates fire —*Santa Barbara Independent.*

PIEDRAS PINTADAS OF COLORADO.

CAPTAIN E. L. BERTHOUD.

I inclose to you three photographs of prehistoric (?) carving that I consider of unusual interest to antiquarians and historians. I have just returned from a railroad survey in the San Juan Mountains, south of the head of the Rio Del Norte, and in Rio Grande County, Colorado; and on this trip I learned that there was a locality near where ancient carvings existed.

The place is twenty miles southeast of Rio Del Norte, at the entrance of the Cañon of the Piedra Pintada (Painted Rock) Creek. The carvings are found on the right of the cañon, or valley, and upon volcanic rock. They bear the marks

of age and are cut in—not painted, as is still done by the Utes everywhere. They are found for a quarter of a mile along the north wall of the cañon, on the ranches of W. M. Maguire and F. T. Hudson, and consist of all manner of pictures, symbols, and hieroglyphics done by artists whose memory even tradition does not now preserve. An examination of the photographs made very closely with a reading lens suggested to me that the center third picture is intended to commemorate the first appearance of the Spanish discoverers in the sixteenth century, in the valley of the Del Norte; their encounter there with the naked natives of the country, and a battle between them and the Spanish cavalry, armed with lances, shields and swords, which the mounted figures are intended to represent.

The fact that these are carvings, and done upon such hard rock, invests them with additional interest, as they are quite distinct from the carvings I saw in New Mexico and Arizona on soft sandstone. Though some of them are evidently of much greater antiquity than others, yet all are ancient, the Utes admitting them to have been old when their fathers conquered the country.

VISIT TO AN ACOMA PUEBLO.

F. P. BAKER.

* * * * * * *

We left McCarty's Station, on the Atlantic & Pacific R. R., in Arizona, at 8:20 A. M. in a double wagon with a Mexican on horseback as a guide, for a visit to an Indian village on the top of a mountain about fifteen miles south of the road. I was told by an old Indian, that within his memory, until the past three months, it had never been visited by an American, although Mexicans often were there.

The drive to the Indian village is through a country of great beauty and picturesque scenery, It was through great parks, with mountains of rocks from 200 to 500 feet high on each side. Some of these peaks look like immense orchards, piñons and small cedar trees representing fruit trees in a *real* orchard. The ground is rich, with deep soil, and only needs water to make it very productive. It is covered with piñons and cedar trees and huge cactuses, and also with bunches of grass that are said to be very nutritious. Quite a number of herds of sheep and horses, belonging to Indians, were seen on the divide. About twelve miles out we began to descend into the upper end of what seemed to be a cañon. After going down a pretty steep declivity we reached the bottom, where we found that the cañon began to open out wider and wider into a beautiful park, with no trees, however, but a rich, deep soil, with bunches of grass thicker than any we had yet seen. This park contains many thousand acres of as beautiful prairie as one often sees. In it are numerous piles of rock, standing out by themselves, ranging from a single rock, perhaps, with a circumference of fifty feet and

a height of 200, to much larger and higher ones. They look like sentinels standing guard over the grandest rock, which is 800 to 1,000 feet high and contains perhaps a thousand acres. It is on the top of this rock that the tribe of Acoma Indians live. The accent is on the first syllable, *Ac.* The last "a" has the broad sound as pronounced in maw. I can only compare it to an island in a small lake, and the other smaller rocks to other islands.

All around the base of this island, or rock, are deep beds of sand, looking for all the world like sand washed up from the bed of the ocean. There is no way of getting up upon the rock but from the side we approached, and then only by wading through a bed of sand to the foot of the rock, and then by steps cut in the side of the rock, zig-zagging up to the top, which is nearly 1,000 feet above the park. At one place there is a natural opening about six feet wide, where a half dozen men could defend themsilves against the approach of a small army. Up these steps the people and visitors have to go to reach the top, and up the same steps went the burros, on whose backs are carried up the wood to supply the 800 people who live on the rock, the wheat and corn which are raised on the plains below, and in fact everything that is consumed by the whole population. Nearly the whole 1,000 acres is nothing but bare, ragged rocks, with hardly a vestige of vegetation. Occasionally a few tufts of grass are seen, and I saw one large piñon tree, the only one on the rock.

There is in one ravine a large peach tree. I don't believe there is another so desolate a place inhabited by human beings, on the face of the globe.

Tradition has it that about 1569 this tribe and the Lagunas got into a quarrel over a right to the water and the Lagunas whipped the Acomas, who betook themselves to this rock as a place of security and finally settled on it, going out into the plain below to cultivate their crops, well armed and prepared to defend themselves against their enemies.

There are three rows of houses, each row about as long as a block in the city of Topeka. They are of adobe, three stories high. One side has no openenings whatever, being a bare wall some thirty feet high. The first story is about thirty-six feet wide; the second story say twenty-six feet wide, leaving an open space in front of it, and on the top of the first story, which is used to sit or squat on and, I guess, sleep on in hot weather. On the top of the second story is a third story about sixteen feet wide, leaving another open space on the top of the second story, which is used for the same purposes as the one below it, to sleep on. There are no openings on the lower story from the ground. The house is entered by going up the first story on a ladder, stepping upon the flat roof of the first story, entering the second story by a door and then going down some steps into the first story. The third story is reached by a ladder from the second story. The inside of the houses are clean, freshly whitewashed, and nearly everything has a tidy appearance.

There is a church, said to be over two hundred years old, which is almost indescribable. In the center is a placita, or hollow square, uncovered. Around this is what might be called a court or hall with small windows, out of which the

approach of an enemy could be seen, and steps be taken to defend the inmates. Opening out of this court are many small rooms, used for shutting people up in, or hiding in, or some such purpose. One of them is now used as a prison. Then on one side of this placita is the church proper. It is built, like all other buildings, of adobe, nearly three feet thick. It has every appearance of great age. There are a few old pictures in it, the Virgin Mary, etc. At one end is a gallery, and the stone steps leading to it are worn nearly out from long usage. At one corner of the church is a tower in which is an old bell, which is rung on the death of any one, and also when the Catholic priest comes from a neighboring village, which is about once a month.

The only water used on the rock is rain-water, which is gathered in a natural cistern from the rain which falls in the rainy season. This natural cistern, as I have called it, is a tank formed by the surrounding rocks. It is about 140 feet long and an average of say fifty feet wide. In the rainy season this fills to the depth of about twenty-five feet. The steps leading down into it are full of holes just the shape of the human feet, where for hundreds of years the women have gone after water, always stepping in the same place from necessity. It is nearly or quite a half mile from the dwellings to the cistern, and one-half of that distance over a bed of sand. The water is all carried on the head in a vessel made of clay and holding about a gallon and perhaps more.

The wealth of the tribe consists in its flocks. They own in common about 20,000 sheep, 5,000 to 6,000 head of cattle, 600 to 800 burros and a large number of horses. They are herded on the plain below. They raise a good deal of corn. It is of a blue variety; also considerable wheat. They keep hens, turkeys and pigs on the rock, and eggs are sold to the merchant, Beppo, at fifteen cents a dozen. While I saw the forked stick plows, I did not see any in use. The corn was planted in an old corn field, without re-plowing. Some of the corn is up and looks well. In other parts of the field corn was being planted by simply making a hole in the ground with a short stick, dropping the corn in it, and covering it with the foot.

There is a tradition that the first priest that ever ventured upon the rock was thrown from a high one, but instead of falling to the ground, as the law of gravition provides, he went up to heaven. The point of rock off which he was thrown was shown me. It seems to me, however, that I have heard a similar story. I am aware that this is a very imperfect description of the place. To have given a fuller account I should have stayed another day. I wanted more to call attention to the fact that there is such a place, than to give an accurate description of it. It will be but a few years at most that such places can be found. It is not probable that this tribe of Indians will live another score of years in such a desolate place.—*Commonwealth.*

ASTRONOMY.

KEPLER'S THIRD LAW.

EDGAR L. LARKIN.

In the November issue of this REVIEW we published an article with the above title in which we said, in speaking of the periods of revolutions of planets and their distances from the Sun, that,—"The squares of the times are equal to the cubes of distances." This is a statement of Kepler's law at variance with those given in astronomical works. Herschel's Outlines, p. 259, gives it in these words: "The squares of the periodic times of any two planets are to each other in the same proportion as the cubes of their mean distances from the Sun." On November 10th we received a letter from Prof. H. S. Pritchett, St. Louis, Mo,, which said,—"As your statement of Kepler's law is calculated to mislead any one unacquainted with the subject, it is proper that you should make some correction of it in the next number."

Thanking Prof. Pritchett for calling attention to this matter, we make the following explanation:

In late computations wherein values relating to the earth become factors, such as its mass, volume, density, distance, velocity, and gravity, we find each made equal to 1. This scheme has become nearly universal, and our object in so wording Kepler's law was to make it applicable to those who were in the habit of using ratios in place of crude numbers. Since no value but a ratio was inserted in the article, we thought our version of the law would be understood to apply to ratios. For fear that students might think otherwise we here show the exceptions to the law as we gave it. The main use of Kepler's third law is to find the relative distances of the planets from the Sun, which of course gives their relative distances from each other.

For many years such use was made of it, until finally it fulfilled its destiny and actually revealed the distances of all the planets from the Sun in relation to the earth's distance.

Kepler beheld the future with joy, because he was aware that if in coming years any astronomer should be so fortunate as to discover the distance of one planet from the Sun in miles, then all would be known, since the squares of times he knew, contained the secret of distances. Astronomers long ago made tables of the relative distances of the planets—including the Earth—from the Sun; and then began an untiring search, awakening the admiration of the world—a search not yet ended—to find the distance of one planet—the earth—in miles.

Let us imagine ourselves transported into the past, and watch astronomers

at work finding the relative distances of the planets from the Sun. They had Kepler's law and therefore knew that there was a *certain* relation between the squares of times and cubes of distances. Suppose them at work on the task of finding how many times more distant Jupiter is from the Sun, than is the Earth. They could all see that Jupiter requires 11.8617 times greater period to revolve around the Sun than the Earth does. Then they squared 11.8617 and secured 140.6 as a product. Here, then, astronomers had a number—140.6, which they knew possessed valuable properties, since by the law, the distances—both unknown—of the Earth and Jupiter were involved in it. They knew that whatever were the distances of the Earth and Jupiter, the cube of Jupiter's distance divided by the cube of the Earth's, would give a quotient=140.6. After years of toil had passed away in observing Jupiter; in watching it in all parts of its orbit, measuring and recording its angular distances from the Earth and Sun, as well as its longitude from time to time, it was discovered by almost interminable labor, that its distance from the Sun is 5.2016 times greater than that of the Earth. Therefore, the distance of the earth from the Sun becomes equal to 1. The relation of the Earth's distance from the Sun to Jupiter's distance is as 1 is to 5.2016.

(We desire to use the word ratio instead of relation, but desist, for if we should, our version of the law would be true).

As noted above, astronomers knew if they could find the relative distances of the Earth and Jupiter with accuracy, that the cube of Jupiter's divided by the cube of the Earth's distance would equal 140.6. But why carry the computation further? Why cube Jupiter's distance and divide by the cube of the Earth's, when the work was already performed? The number 140.6 flashed out as a resplendent light, for behold! it *is* the cube of 5.2016. That is:—the square of Jupiter's time is *equal* to the cube of its distance, in the only units that could possibly be known to the astronomers of that epoch.

It would have been well if these founders of our science had erected a monument of granite, more enduring than the pyramids, and carved thereon these words: "The squares of the times of revolution of all the planets are equal to the cubes of their mean distances from the Sun." We think no astronomer now living would desire to obliterate such an inscription. This eternal law is one of the foundation stones of astronomy and we think all text-books should word it as above, and that every student should so memorize it. If any man ask that we explain the third law of Kepler, we will tell him that squares of times are equal to cubes of distances. Should he ask how to find the times, we would say: the only known method of finding the time of a planet's revolution is to observe how much longer or shorter period it requires to make circuit than the Earth does, because the motions of the Earth alone give us any conception of the flow of time. He desires to find the distance of Mars from the Sun in miles. We say square its time and extract the cube root of the product. The period of this planet is 1.88, that is—it takes .88 longer time to go round the Sun than the Earth does. The square of 1.88=3.537, whose cube root is 1.5238. Now, we

assert that 1.5238 is the distance of Mars from the Sun, and re-assert that—the square of any planet's time is equal to the cube of its distance. Our reasons for saying that 1.5238 is the distance of Mars are, because we cannot find Mars' time without first finding the Earth's, nor its distance, likewise. Since we are forced to make the Earth's period 1, we claim the right to make its distance 1. Therefore, if we can find the distance of the Earth in miles, we have only to multiply this number by 1.5238 to find the distance of Mars in miles. But the Earth's distance is still unknown, so we assume the solar parallax to be 8″.8 which makes the Earth's distance, 92,882,000×1.5238=141,534,000 miles=the distance of Mars.

Thus, distances of all planets in miles can be found from their periods, with fifty times less labor than by any other process. And this is the only way in which Kepler's law should ever be used. We found the distance of Mars with little work, but will give the same case in the good old way, using numbers that appall the young student. We hear on all sides that—"the squares of times are *proportional* to cubes of distances." We know it, and will show some of the proportions in the case of Mars and the Earth. Mars' time is 686.9766 days, whose square=471,940. The Earth's period is 365.2563 days, which squared=133,412, and 471,940÷133,412=3.537. Now, as we know this to be equal to the cube of Mars' distance, we would like to take its cube root at once and end the matter; but no, we must secure the same number by the proportional way. The Earth's distance, 92,882,000 miles, whose cube=801,834,445,006,000,000,000,000. Mars' distance is 141,535,000 miles, and cubed=2,835,251,231,305,000,000,000,000. To be proportional to squares of times, quotients must be equal, whence, 2,835,251,231,305,000,000,000,000÷801,834,445,006,000,000,000,000=3.537 as before; but then this 3.537 is the *cube* of Mars' distance, and we must proceed as at first to extract its cube root. Using Kepler's law, in the proportional way, is like burning all the logarithmic tables in existence. We cannot concieve of dispensing with a unit of time in cosmical physics, and fail to find one better than the year. The earth revolves in a time which is equal to 1; now let us see if we have violated mathematical usage in calling the Earth's distance 1, as we do its time. The ablest mathematicians make such statements. Thus:—in Newcomb and Holden's Astronomy, p. 228, it is said in formula that the force of gravity on the Earth's surface multiplied by the square of its radius equals the *mass* of the Earth.

Gravity on the Earth's surface=32.1 feet per second; and radius=20,899,081 feet; and 20,899,081 squared and multiplied by 32.1=14,020,367,931,290,408, which we are informed is the mass of the Earth. But it is not the Earth's mass in pounds, tons, or any other units. Is the assertion of such able astronomers false? By no means,—everybody at once understands that this vast number is equal to 1, that is, it is nothing but a ratio, for if we multiply gravity on the Sun's surface by the square of its radius in feet and divide the square by the above number, the quotient will be 333,426, an important number—the mass of the Sun, that of the Earth being 1. Here, a string of seventeen figures was

made equal to 1; then we see no reason why 92,882,000 may not be represented by 1, and Kepler's law be allowed to stand in simplicity and sublimity.

This reasoning appears to us satisfactory, that we have a right to make the Earth's distance unity, and then word the law as we did.

Now for the exceptions—of which there are five, as follows: The squares of the times expressed in months, weeks, days, hours, and minutes, *do not* equal the cubes of distances in furlongs, rods, yards, feet, and inches. But since no one wants to use the law by handling these units, we did not make mention of them in the Kansas City REVIEW. Yes, we omitted the units—years, because if we used *years*, the number 1 would appear; and distance would have to come into the list as 1, spoiling the scheme, since squares of times at once become equal to cubes of distances.

We would much rather teach that squares of times equal cubes of distances; than that they are simply proportional. We would teach equality first, and make secondary the fact of proportion. We would exalt this *equality*, and class the proportions existing among these numbers as mathematical curiosities like others that may be deduced by different combinations of values of time, velocities, distances and the like. Here is a table of proportions existing in the solar system, beginning with Mercury and extending to Neptune.

The square of Venus' Time	÷by the square of Mercury's Time	= 6.5
The cube of Venus' Distance	÷by the cube of Mercury's Distance	= 6.5
The square of the Earth's Time	÷by the square of Venus' Time	= 2.64
The cube of the Earth's Distance	÷by the cube of Venus' Distance	= 2.64
The square of Mars' Time	÷by the square of the Earth's Time	= 3.537
The cube of Mars' Distance	÷by the cube of the Earth's Distance	= 3.537
The square of Jupiter's Time	÷by the square of Mars' Time	=39.8
The cube of Jupiter's Distance	÷by the cube of Mars' Distance	=39.8
The square of Saturn's Time	÷by the square of Jupiter's Time	= 6.16
The cube of Saturn's Distance	÷by the cube of Jupiter's Distance	= 6.16
The square of Uranus' Time	÷by the square of Saturn's Time	= 8.13
The cube of Uranus' Distance	÷by the cube of Saturn's Distance	= 8.13
The square of Neptune's Time	÷by the square of Uranus' Time	= 3.83
The cube of Neptune's Distance	÷by the cube of Uranus' Distance	= 3.83

Quite a number of similar tables might be made by beginning the series with each of the planets; and then by different combinations arranging the numbers in all possible ways. We might begin with Saturn and compare with the other planets; and then with Uranus, and so on, completing the work probably in six months. But then what would the tables be good for, simply to satisfy a curiosity that might be awakened in a morbid mental condition.

Nearly every work on astronomy fails to quote Kepler's law correctly; all astronomers know that as Herschel gives it, it is not absolutely perfect. The words, "when the masses of the planets are considered" should have been added. The third law is not true with mathematical precision unless the mass of each

planet is allowed to enter the calculation. The error is perceptible in the case of Jupiter, but the combined mass of all the planets is so small in proportion to the Sun, that very few writers care to waste additional words when quoting the law. In view of the fact that late astronomical works make such frequent use of ratios, and since Kepler's laws are so well known, we here present four sentences whose differences are almost infinitely small. "The squares of the periodic times of any two planets are to each other in the same proportion as the cubes of their mean distances from the Sun."—Herschel.

The squares of the periodic times of any two planets are to each other in the same proportions, when their masses are considered, as the cubes of their mean distances from the Sun.

The squares of the times are equal to the cubes of distances, when ratios are considered.

The squares of the times are equal to the cubes of distances.

And these ratios are units formed by the same hand that made the solar system; and should never be forgotten, whether by student or skilled astronomer.

With due deference to Prof. Pritchett, we make these explanations and corrections.

In November issue "Axis" should have read Axes, and ".1" as 1.

NEW WINDSOR, ILL., November 20, 1883.

SUN AND PLANETS FOR DECEMBER, 1883.

W. DAWSON, SPICELAND, IND.

The Sun's R. A. is 16 hours 30 minutes on December 1st, and 18 hours 42 minutes on December 31st. About 9 P. M., of the 21st, the Sun will arrive at his greatest declination south, 23° 27′; a point called the winter solstice—the astronomical beginning of winter season. It is 18 hours 00 minutes of R. A.—the solstitial Colure, and 6 hours west of the Vernal Equinox. This will be the shortest day of the year—9 hours 10 minutes long in 40° north latitude. After that the Sun will decline northward and the days grow longer. The Sun will be nearest the Earth on January 1st. Solar spots are not so numerous as they were in October; ninety-five spots is the greatest number yet observed in November, on the 1st and 17th. Two were visible without telescope on the 17th, one near the west edge of the Sun, the other in southeast quadrant.

Mercury is evening Star, but will not be visible until near the last of the month, when it may be seen in evening twilight near where the Sun sets. Venus is also evening star, and will be somewhat conspicuous by the end of the month, about half an hour above Mercury. Saturn will be a lovely object all through December; rising at 4:30 on the 1st, it will be high enough for observation soon after dark. As stated on former occasions, a good sized spy-glass will show the ring and one or two moons; and a large telescope brings out a magnificent ap-

pearance. Saturn may still be known by its proximity to Aldebaran—being somewhat above and to the left of the star. Jupiter rises about 8:30 P. M., four hours after Saturn, and near the same point of the horizon. And here we have another grand object for telescopic observation. A very small glass shows a disk on the planet; the four moons and one belt. Mars rises just before 10 P. M., on the 1st, a little south of where Jupiter emerges to view. It rises one hour twenty-three minutes later than Jupiter on the 31st. Its phase is gibbous and not of much interest with a small glass. Uranus is morning star, rising at 1 A. M., on the 1st, and two hours earlier on the 31st. Neptune is still about 8′ southwest of Pleiades. The Moon passes Neptune on the 11th; Saturn next day; Jupiter in evening of the 16th; Mars in morning of the 18th; Uranus early on the 21st; the Sun (New Moon) on the 29th 6:30 A. M.; Mercury at 11 P. M. on the 30th; and Venus near 1 P. M. on the 31st.

REAPPEARANCE OF THE COMET OF 1812.

On the 3rd of September, Mr. Brooks, of Phelps, New York, discovered a telescopic comet. Its advent was quickly made known to the scientific world, and it was described as round and faint, and having no tail. Its course was toward the earth, and it was hoped that it would become visible to the naked eye in two or three months. It was generally accepted as a new comer making its first visit to the clime of the Sun, and was known as comet Brooks, or comet *b* 1883.

Instead, however, of being a new-comer, this comet is an old friend that made its first recorded visit in 1812, and is known as Pons' comet from the name of the discoverer, or, more simply, as the comet of 1812. Encke, an astronomer of the time, found that the comet moved in an ellipse with a probable period of nearly seventy-one years, so that its return was looked for about this time.

The Rev. George Searle, of New York, was the observer who discovered the identity of comet Brooks and the comet of 1812.

Cometic astronomy was comparatively in its infancy when Encke made the computation of the orbit of this comet. It is simply wonderful that, with the data at his command, he should have reached a result so nearly accurate. Within a few years, however, two series of observations of the comet have been discovered which were unknown to Encke. Two French astronomers, Messrs. Schulhof and Bossert, undertook to recompute the orbit, using all the data known. The Paris Observatory published the result of their labors in a pamphlet of 200 pages. From time to time, the enthusiastic French observers issued memoranda of the probable position of tne comet when near enough to be seen. Unfortunately, the first observations of comet Brooks did not seem to agree with the French ephemeris, and it was hastily concluded that the erratic visitor was a new member of the cometic family, come to take its first peep at our little planet.

The Rev. Mr. Searle studied the question more carefully, and verified the

computations more accurately. He proved beyond question that the positions marked out for comet Brooks were identical, at the time of observation, with those in which a comet would be found that was traveling in the ellipse computed by Encke. He went further, using the new orbit of the French astronomers, and proving that the comet was observed in the exact position where it should have been found according to the orbit computed seventy years ago.

There is, therefore, no shadow of a doubt that our eyes behold the long expected comet of 1812. Its perihelion passage will take place on the 25th of January, 1884. It will then be about 60,000,000 miles distant from the earth, two-thirds the distance of the Sun.

In 1812, the comet presented, when discovered in July, the appearance of an irregular nebulous mass, with the tail entirely wanting. In September, the nucleus was 5′ in diameter, and the tail was 2° 17′ in length. Though not very bright, it was distinctly visible to the naked eye, and was observed for ten weeks before it disappeared in the star depths. The returning comet, when first seen, presented similar elements. About the 23d of September, however, a remarkable and unexpected outburst occurred, the nucleus expanding into a confused circular nebulous patch of light, and the comet increasing many times in brilliancy in the course of two or three days. On the 23d, the nebulous mass was 2′ in diameter; on the 25th, it was 4′ in diameter and shone with a lustre equaling a star of the seventh magnitude. The activity of the display is almost unparalled in cometic history, and is especially noteworthy on account of the comet's great distance from the Sun at the present time. Since this curious outburst, the comet has been a well behaved member of the family, but it is impossible to predict what vagary it may next indulge in.

The comet of 1812 may now be seen in the evening in the northwest in a telescope of moderate power, and is said to be visible in a good opera-glass. In a few weeks it will be easily perceptible to the unassisted eye, and when the year 1884 makes its advent, it will be near its culminating point. It will not equal the superb comet of 1882 in size or brilliancy, but it will be visible in the evening sky and will be so much more convenient to observe that there will be compensation in its lessened splendor.

It is an astronomical triumph, that with the inadequate means at command for computing an ephemeris, an astronomer seventy years ago was able to predict nearly the exact time for this comet's return. Our ancient friend is winging its swift flight toward us, and before long our eyes will be gladdened by a sight of its face after a long travel of threescore years and ten, when almost every eye that noted its first appearance has ceased to behold the shining picture that nightly arches over the earth.

There are several comets with a computed period of from seventy to seventy-five years. Halley's comet with a period of seventy-five years is the only one of them that has made more than one return. Its last appearance was in 1835, and it is next expected in 1911. The comet of 1812 with a period of seventy-one years

now records its first return. The comet of 1815 with a period of seventy-four years is confidently anticipated in 1889.—*Scientific American.*

METEOROLOGY.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Oct. 20th to 30th.	Nov. 1st to 10th.	Nov. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	. .	. .	. .	. .
Max	.	. .	. .	. .
Min. and Max	. .	. .	. .	. .
Range	. .	. .	. .	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	42 2	43.0	31 7	39.0
2 p. m.	52.0	60.8	46.9	55 9
9 p. m.	44.0	48.6	36.1	42.9
Mean	46.1	50.8	37.4	45 9
RELATIVE HUMIDITY.				
7 a. m.	.91	.90	.89	.90
2 p. m.	.77	.78	.72	.76
9 p. m.	.87	.88	.80	.85
Mean	.—	.85	.87	.84
PRESSURE AS OBSERVED.				
7 a. m.	29.06	28.57	29.21	28.98
2 p. m.	29.09	28.57	29.18	28.94
9 p. m.	29.07	29.00	29.08	28.94
Mean	29.07	28 71	29.16	28.95
MILES PER HOUR OF WIND.				
7 a. m.	9.	10.8	. .	. .
2 p. m.	15.	11.3	. .	. .
9 p. m.	12.	9.6	. .	. .
Total miles	3438	2194	3744	9376
CLOUDING BY TENTHS.				
7 a. m.	5 7	4.5	. .	. .
2 p. m.	5.9	5 4	. .	. .
9 p. m.	6.7	6.2	. .	. .
RAIN.				
Inches	1.70	.70	.00	2.40

The last decade of October was very wet, making a total rainfall for that month of more than twice the normal at this station. The total was 6.14 inches.

November has been, to the 20th, comparatively free from rain, but the humidity was high and the weather cool.

Temperature on the 14th, 15th, and 16th, fell to 14°, 14°, and 15° respect-

ively, which froze the ground enough to nearly spoil undug potatoes. The highest temperature in the report was 73° on October 28th.

REPORT OF THE CHIEF SIGNAL OFFICER FOR 1883.

In this report the Chief Signal Officer of the Army calls attention to the injurious curtailment of the service rendered necessary on account of the diminished appropriations by Congress. He urges increased appropriations for the future, and reports a deficiency bill to enable him to continue work already begun.

Referring to the weather indications, he says: The abandonment of stations made necessary by lack of funds must interfere with the weather predictions made by this office.

He gives numerous details of the fitting out of the Greely Relief Expedition and of the instructions issued for its guidance, but makes no allusions to its failure.

He says the scientific work of the bureau has been steadily carried forward. During the year an investigation has been made into the standard of thermometry adopted by the Service which appeared open to objection. This resulted in the adoption of a new standard which no longer agrees with that of the Yale College Observatory, but approaches more nearly to that of the International Bureau of weights and measures.

Attention is called to the necessity of a separate office on the Pacific Coast, under the charge of an instructed officer, and the report says: "If a weather service for the country is to be maintained, this important region should not be neglected as it has been."

The number of stations in operation on June 3, 1883, was 376—a decrease during the year of 118.

The report shows that the Service has made a slight gain in accuracy. Of the cautionary signals displayed 83.9 per cent were justified by results against 83 per cent last year. Eighty-eight per cent of the weather indications furnished the press were verified, as against 86.6 last year. On the Pacific Coast the verification of weather predictions was 90.5 per cent. Commercial bodies throughout the country have greatly aided the Weather Bureau. In fifty-four cities meteorological committees have been appointed and have furnished suggestions and advice.

The Bureau has made an investigation as to the relation between rainfall and growth of population in the northwest. There was also a careful study of the river floods in 1882 in order to discover some means of predicting such phenomena. Preliminary steps were taken toward better study of cloud formation by the aid of photography and the study of atmospheric electricity with a view to predicting local tornadoes.

The Service has suffered from the lack of officers capable of making weather predictions. Two years' training is requisite, and there are not enough capable

officers to make the predictions and make a scientific study of the vast collection of meteorological data now on hand.

The number of stations in operation at the close of the year was 376, or 118 less than at the close of the preceding year. The number of stations from which telegraphic reports have been received is 139, a decrease of 13. Daily reports have also been received from 335 foreign stations, including 19 in British North America, and irregular reports at intervals from 605 steamships of 59 different lines, Monthly reports have also been made to the Chief Signal Officer by 339 voluntary observers in various parts of the United States.

The work of the Service has been done by 19 officers and 500 enlisted men.

During the last two years an attempt has been made to secure the enlistment of young college graduates, and it has met thus far with gratifying success. Out of 172 enlistments made within the period mentioned, 53 have been graduates of colleges.

Among the improved methods of distributing weather predictions introduced during the year, is that by means of railway trains. The Cleveland, Akron & Columbus Railway has adopted a system of weather signals which are displayed on their cars, and which thus give warning to the farmers of the country through which the line passes. A red ball denotes higher temperature; a red crescent, lower temperature; a red star, stationary temperature; a blue ball, general rain or snow; a blue crescent, fair weather; a blue star, local rain or snow. The predictions are sent to the road at midnight. The average percentage of accuracy of the warnings given in this way, as determined by persons not connected with the service, has been over 80 per cent. Arrangements are now making to extend this system to all lines of railway operated by the Baltimore & Ohio Railroad Company.

BOOK NOTICES.

WORLD-LIFE, OR COMPARATIVE GEOLOGY: By Alexander Winchell, LL. D.; 8vo., pp. 642. S. C. Griggs & Co., Chicago, 1883. For sale by M. H. Dickinson, $2.50.

This book, which gives the author's views of the processes of world formation, world-growth, and world decadence is, in the main, made up from lectures delivered before his classes and before popular audiences during the past fifteen years or more, but presents the ideas, theories, and arguments in a more substantial and profound manner. It is intended to be an incorporation of the soundest and latest views of the best writers upon the various branches of the subject with the carefully drawn conclusions of the author; the whole discussion, as he says, being conducted from the standpoint of nebular cosmogony, which "has shaped the views presented on the accumulation of the materials for world-

formation, on the evolutions of nebulæ, stars, and planets, on the all-important influence of tidal-action in cosmic history, and on the grand cycle of cosmic existence."

It is divided into four parts: I. World Stuff with chapters upon Cosmical Dust and Nebular Life. II. Planetology, subdivided into essays upon the Origin of the Solar System, the General Cosmogonic Conditions on a cooling Planet, Special Planetology or Present Conditions and Cosmogonic History of the Planetary Bodies in our System, Planetary Decay or Cosmic Conditions more advanced than the Terrestrial Stage, Habitability of other Worlds. III. General Cosmogony, which includes discussions of the fixed Stars and Nebulæ, and of the Cosmic Cycle. IV. Evolution of Cosmogonic Doctrine, with an interesting account of Pre-Kantian Speculations, Kant's General History of Nature, Doctor Lambert and Sir William Herschel, and LaPlace's System of the World.

In presenting many of his theories Professor Winchell undoubtedly is entitled to the credit of having preceded many of his contemporaries, at least in his public lectures. For instance, he enunciated the theory of the vast quantity of cosmical or meteoroidal matter and its influence upon planetary motions some years before the investigations of Nordenksjold, Tissandier, and others. On the geology of the Moon his reasonings were in writing considerably before M. Faye's memoir appeared in which some coincident conclusions were reached without covering the same ground. He also first pointed out the importance of the atmospheric factor and the ice-clad condition of the ultrajovian planets.

He has made an effort to clear up the most serious difficulties encountered by belief in the nebular origin of the planetary system, for which he has stood up for many years, and of which he says, "the great idea was fascinating, its magnificence took possession of the imagination and its symmetry and coherence commanded rational conviction. It now commands the admiration and championship of the scientific world." Monographic summaries of various scientific doctrines, such as replies to objections to the nebular theory, views upon cosmical matter, estimation of the earth's age, etc., occupy a number of pages and are also full of original suggestions.

Copious foot notes give not only full bibliographical references and authorities, but in many instances mathematical operations, showing the author's processes; at the same time the text may be read separately for a logical treatment of the subject without following it into obtruse and recondite depths.

It is impossible to touch upon one in a hundred of the salient points in this work, and still we hope we have said enough to show the reader that it is one of powerful vigor, deep research and profound thought; worthy of the author, even after all his other works, and instructive and suggestive to students of every degree. The publisher's work has been well done, and nothing is lacking to make the book attractive in appearance.

THE SUN: ITS CONSTITUTION; ITS PHENOMENA; ITS CONDITION. By Nathan T. Carr, LL.D.; *Humboldt Library*, No. 49. J. Fitzgerald, New York, 1883.

One of the results of the attempts to popularize science has been the production of a class of writers who, without the training or knowledge necessary to the task, aim to produce explanations and theories in provinces where, as it might almost be said, "angels fear to tread." While the book under discussion cannot unreservedly be classed among these productions, it is so markedly on the border line between them and the works of well informed men that it is, for this reason, the more dangerous. The departure from accuracy of statement is frequently so slight that only one conversant with the subject would notice the delinquency. In the hands of persons, whether liberally educated or not, who are not familiar with the minutiæ of solar research the book cannot fail to produce erroneous and hurtful impressions.

It is at once evident that the author has never studied solar phenomena with the aid of good instruments, the *sine qua non* of knowledge in this department. His descriptions are misleading, and the discussions founded upon them err accordingly. The most prominent example of this error is the confounding the corona with the chromosphere, and the prominences with the faculæ; (§§ 9, 10, 11). But it is in the application of the principles of physics to the study of the constitution of the Sun that the most serious inconsistencies are found. There is a continual interchange of the terms 'cloud' and 'vapor,' 'fluid' and 'liquid;' and a clear idea of the essential properties of a gas seems to be entirely wanting. We find an incorrect view of the formation of a gas by heat given at some length (§ 15); the doctrine of the conservation of energy totally denied (§ 16); decided misapprehension of gaseous pressure (§ 18); and the attraction of gravitation entirely overlooked (§ 22). With this armory to fall back upon, it is not strange that the author should criticize the recognized masters of this department of research with considerable freedom and not without a slight flavor of pity and superiority. The danger to be feared from the publication of this book is the effect it will have in misleading persons who are anxious to know somewhat concerning our central luminary, but are not prepared to distinguish between the true and the false. To the student of the subject the book can have no interest excepting that belonging to a curiosity. H. S. S. S.

FINLAND: ITS FORESTS AND FOREST MANAGEMENT. Compiled by Jno Croumbie Brown, LL.D. 12mo., pp. 290. Oliver & Boyd, Edinburgh, 1883.

This is the third of a series of volumes, the publication of which has been undertaken as a contribution to the literature of forest science in the English language. The earlier volumes, "The Forests of England, and their Management in Bygone Times," and "The French Forest Ordinance of 1869, with Historical Sketch of Previous Treatment of Forests in France," have been noticed in these pages. Doctor Brown is an indefatigable student of such subjects has already

published seven volumes on forestry, and has some three or four others under way. The object aimed at by him is to produce popular technical treatises which may be useful to students of forest science, who have not access to the works quoted, and to place his readers in a position to work out for themselves solutions of the problems raised, should they be so disposed.

This volume is divided into three parts, viz: I. The Lakes and Rivers of Finland with descriptions of the Saima Sea: Boating Adventures on the Ulea and the Tornea of the water systems of Finland. II. Forest Economy, with an account of the Primitive Treatment of Forests in Finland, including details of the practice of "Sartage" or "Svedjande" in Finland and adjacent lands, and Forms Assumed by the practice of other lands, followed by several chapters discussing the evils, merits, demerits and climatic effects of the practice in India, France, and Finland; Development of Modern Forest Economy in Finland; Forest Administration, Protection, and Exploitation; Forests and Forest Trees; Disposal of Forest Products, etc. III. Physical Geography, embracing chapters upon the Contour of the country, Geology, Fauna, Flora, and Climate.

The work is quite comprehensive, as this summary of its scope and contents shows, and its author has been very fortunate in reproducing in an attractive manner the results of his studies while on a vacation from his ministerial duties, a few months in the summer of 1879.

SEA-SICKNESS: ITS CAUSE, NATURE, AND PREVENTION. By Wm. H. Hudson. 16mo., pp. 147. S. E. Cassino & Co, Boston, 1883.

In this little volume the author presents a method by which, as he claims, the ocean traveler may secure immunity from sea-sickness without change in diet or aid of medicine. He asserts that this terrible affliction to most travelers is due wholly to violation of natural laws through ignorance of their true nature and that its prevention is possible to all by the use of correct principles, simple in themselves and easy in their application. The whole secret seems to be the yielding of the body to, instead of resisting, the motions of the vessel; complete relaxation of all the muscles and relinquishment of will. We, who have lived long in this region remember the horseback riding of the Mexican *vaquero*, his perfect abandonment to the action of the animal; this on shipboard results in perfect avoidance of sea-sickness, if our author is to be believed, and he speaks from an experience of thirty-five years. In addition to this the voyager's diet should be simple, his habits regular and his conscience as clear as possible. Many other suggestions are made, but the above are the principal ones and the first is the only one peremptorily insisted upon. The book can be read in an hour and it is well worth the attention of all who "go down to the sea in ships."

THE THEORY OF MORALS. By Paul Janet; translated by Miss Mary Chapman. Octavo, pp. 490. Charles Scribners' Sons, New York, 1883. For sale by M. H. Dickinson, $2.50.

The object of the author in this volume is to go back to first principles and to define precisely the fundamental ideas of morals and to proceed logically to a systematic and well connected exposition of them. It is apparently intended as supplement to the "Elements of Morals" published in 1869 by the same author, in which he presented the subject in an elementary form, adapted to the young, and divested of all metaphysical discussion and abstruse reasoning.

Professor Janet takes up the question at the germinal point, calls to his aid such authors as M. Jules Simon, M. Renouvier, M. Ferraz, M. Ad. Franck, Mme. C. Coignet, M. E. Wiart, M. Herrenschneider, all writers of distinction on the subject of Morals, adds to their elucidation the powerful light of his own intellect and develops a scheme which, as he modestly claims, contains some elements too much neglected heretofore, some untangled intricacies, some solutions of involved points and some suggestions for future investigators.

In setting forth he adopts the position of the philosopher, Schleiermacher, in resolving all moral ideas into three fundamental ones, viz: the idea of good, the idea of duty, and the idea of virtue, and takes this distinction, with a free interpretation, as the basis of his theory of morals. To show the course of reasoning in this primary statement we quote a few sentences: "These ideas may be said to follow each other and to be linked together in the following order: good, duty, virtue. Virtue indeed, according to the most generally accepted definition, consists in following one's duty, that is to say, in following that rule of action which our reason commands or advises. Duty, in its turn, consists in doing that which is good, it is the rule of action required of us by the practice of good. Thus virtue presupposes duty, and duty presupposes good. If there were nothing good, there would be no rule of action to teach us to choose one object rather than another, there would be no duty. If there were no duty or rule of action, there would be no virtue, that is to say, no enlightened choice between good and evil. Hence, an enlightened choice of good—that is to say, virtue—presupposes a rule of choice, or duty, which again presupposes a reason for the choice—that is to say, a good." Following this is a close discussion of the real definition of these three terms, resulting in the conclusion that "objective moral science will be the theory of good; formal moral science will be the theory of duty; subjective moral science will be the theory of morality or of virtue."

This is the basis of the whole work, and the remainder of the volume, say four hundred and eighty-five pages, is devoted to an examination and discussion of "the points of view first of those who consider, in moral science, nothing but the subject; second, of those who consider only the form of the object, i. e., the philosophy of pleasure; and the philosophy of duty." The ultimate theory unfolded in the discussion seems to be that "Morality leads to religion, which is simply belief in the divine goodness. If the world is not derived from good and does not go to good, virtue is a powerless chimera. *Practical* faith in the

existence of God is then what Kant has called it, the postulate of the moral law."

This is a very weak and imperfect suggestion of the object and scope of the work, which must be carefully read to be fully comprehended, and the reader must be possessed of a truly philosophic mind to attain that full comprehension.

SEVEN SPANISH CITIES. By Edward Everett Hale. 12mo., pp. 328. Roberts Brothers, Boston, 1883. For sale by M. H. Dickinson, $1.25.

If readers of travels do not learn all that is desirable to be known about Spain soon, it will not be the fault of the authors and publishers. Within the past year or so, we have had "Spain and the Spaniards," by De Amicis, and "From the Pyrenees to the Pillars of Hercules," by Henry Day, besides other books, magazine articles and newspaper correspondence in abundance, and now Rev. Edward Everett Hale comes up with "Seven Spanish Cities," published by Roberts Bros., of Boston. The consolation in this special case, however, is that Mr. Hale is always sparkling and original, never dull or imitative. If he were to write a work on wood-sawing it would doubtless be spicy and piquant to an high degree, while the truly American habit of seeing everything that others see, and a great deal more, would manifest itself openly.

This little work is the result of observations made during a few weeks' passage through Spain in May and June of 1883. There is very little of fact either in description or history that is new, but upon closing the book one has the impression of a new revelation. Madrid, Cordova, Seville, Saragossa, or Zoragoza, as he writes it, are all invested with a new interest. We have the facts as heretofore, but a kind of halo of freshness surrounds them, a play of fancy and humor, never wanting in any of Mr. Hale's efforts, that attract the reader and hold his attention to the work, even when other works on the same subject lie before him unread, or merely skimmed over.

It is presented by the publishers in a very neat and attractive style.

THE BOYS' AND GIRLS' PLUTARCH. By John S. White, LL.D. 8vo., pp. 468; Illustrated. G. P. Putnams' Sons, New York, 1883. For sale by M. H. Dickinson, $3.00.

Plutarch has been for more than 1600 years a source of information and inspiration to the students and writers of most nations and languages. He wrote more books than almost any other ancient author, and the same sprightly and attractive vein pervaded them all, while his accuracy is in most matters unquestioned.

The volume under consideration has been especially prepared by Professor White, long Head-Master of Berkeley School, for the use of boys and girls. It is most handsomely printed, bound, and illustrated by the publishers, and the subjects selected are well chosen, both for the entertainment and instruction of the

readers for whom the work is intended. We select a few at random: Life of Theseus, Lycurgus, Solon, Themistocles, Demosthenes, Cicero, Alcibiades, Quintus Fabius Maximus, Cato, Alexander the Great, Cæsar, etc.; also comparisons of the lives of Theseus and Romulus, Demosthenes and Cicero, Alcibiades and Coriolanus; also descriptions of the Engines of Archimedes, the noble character of Caius Fabricius, the Death of Cæsar; with tables of weights and measures mentioned by Plutarch, a chronological table, and an index for reference as to the pronunciation of proper names, etc. There are forty-five illustrations, well selected and handsomely executed.

We know or no book more likely than this to be fully appreciated by boys and girls.

ENGLISH VERSE: Edited by W. J. Linton and R. H. Stoddard. Five volumes, 16mo., pp. 300 each. Chas. Scribner's Sons, New York, 1883. For sale by M. H. Dickinson, $1.00 per volume.

The volumes referred to above are: I. Chaucer to Burns; II. Lyrics of the 19th Century; III. Ballads and Romances; IV. Dramatic Selections; V. Translations. Of these but the first two have been published; the others are, however, to follow in rapid succession and all are promised by December 1st. Each volume contains as an introduction an essay by Mr. Stoddard on the period or class of English poetry which it covers. The poems of each author are grouped together, and at the end of each volume are brief biographical and bibliographical notes by the editors upon the poets represented in it.

The advantage of this collection over the many that have preceded it is that it covers more completely than any other, the whole field of English poetical literature. At the same time its division into five moderate sized volumes is a far more convenient arrangement than that of a single massive tome as is frequently the practice. The arrangement of clearly distinct subjects or classes by volumes and giving the poets chronologically in these volumes is an admirable one. All of the old familiar masterpieces are found, and many notable omissions of previous collections supplied, so that in comprehensiveness this will be unequaled, while the work of the editors, at home and abroad, in verifying the texts of the several authors has resulted in giving us an absolutely perfect and reliable edition. The notes added to many of the pieces will surprise the reader who has been accustomed to regard the ordinary versions as correct, by showing him numerous inaccuracies and abridgements in some of the most familiar poems.

Each volume is supplied with careful indexes of authors, poems and first lines. The paper, type, press-work and binding are good, and the price is unusually low.

HISTORICAL SKETCHES OF NEW MEXICO. By L. Bradford Prince. Second edition; 12mo., pp. 330. Ramsey, Millett & Hudson, Kansas City, Mo. For sale by The Kansas City Book and News Co.

No one is better prepared than Judge Prince to write a history of New Mexico, not only from his long residence in the Territory, but from his late position as its Chief Justice and as President of the Historical Society of New Mexico, as well as from his tastes and literary habits; but a complete history cannot be written by any one, from the fact that most of the records prior to 1680 were burned in the Pueblo Rebellion, many of those of more recent date were sold for waste paper by Governor Pile, and so lost or destroyed, and the remainder are unpublished and generally unavailable at present for the purposes of the historian.

In spite of these facts, Judge Prince has succeeded in working up a very valuable compendium and also in putting it into an attractive and readable shape; having consulted all of the leading authorities—both Spanish and American—for events long past, and having pressed into service most of the principal citizens of the Territory for information of value on its more recent history.

He divides the history of New Mexico into three epochs: the aboriginal or Pueblo, the Spanish, and the American, and devotes twenty pages to the first, about one hundred and eighty to the second, and nearly one hundred to the last.

Without going into particulars, we may say that the whole book will be found intensely interesting, especially to the people of the western portion of the United States, who have had so close an intercourse with the country and its peculiar people for the past fifty years or more.

OTHER PUBLICATIONS RECEIVED.

The State University: Its Work and Its Place in the Public School System, J. A. Lippincott, LL.D., Chancellor Kansas State University, pp. 17. The *Homiletic Monthly*, November, 1883, Vol. VIII, No. 2; I. K. Funk, D. D., Editor, 64-pages, monthly, N. Y., $2.50. Report of the Department of Health, City of Chicago, 1881–2, pp. 177. Annual Report of the Commissioner of the General Land Office, 1883, Hon. N. C. McFarland, Commissioner. *Welcome Tidings*, Vol. II, No. 3, Rockford, Ill., E. F. Golden, Editor, $1.00 per annum. On Some Phosphides of Iridium and Platinum, Prof. F. W. Clarke and O. T. Joslin, Laboratory of University of Cincinnati. Village Committees of Cape Anne and Salem, by Herbert B. Adams, Ph. D., pp. 81. *Young Scientist*, Vol. VI, No. 10, edited by John Phin and F. T. Hodgson, New York, monthly, $1.00. Report from Consuls of the United States on Commerce, Manufactures, etc., of their Consular districts, No. 32, August, 1883, pp. 414. *Scientific and Literary Gossip*, Vol. I, No. 12, October 15, 1883, S. E. Cassino & Co., Boston, 50c per annum. *Journal of Progress*, Vol. I, No. 1, October, 1883, edited by J. H. Bently, Philadelphia, Pa., 60c per annum. *V. P. Journal*, Vol. I, No. 1, edited and published by James Elliott, Cobourg, Ont., $1.00 per annum. The *Bio-*

graphical Magazine, November, 1883, New York, $1.00 per annum. *The Manufacturer*, Toledo, O., Vol. I, No. 1, $1.00 per annum, Chas. Reed, Editor and Publisher.

SCIENTIFIC MISCELLANY.

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

PAPER ELECTRIC INSULATOR.—An Electric Insulator is now constructed of paper-pulp. Liquid silica, or silicon, is used as a cementing agent, and when these constituents are combined in proper proportion, a superior insulator is produced, covering at once, all the ground heretofore almost monopolized by the different forms of glass. This improvement is the subject of a patent recently granted to Charles C. Hinsdale, Cleveland, Ohio.

EXTENSION STEP-LADDER.—A very convenient device in step-ladders, has the front and rear stiles longitudinally slotted, each adapted to slide respectively one upon the other. The lower stiles have hinged brace-rods provided with pins which slide in the slots of the inner or upper stiles. There are also spring catches which secure the parts in their places after adjusting the ladder to any desired height. Patented by Messrs George A. Bell and W. W. Norman, Morley, Mo.

APPARATUS FOR OILING ENGINE CYLINDERS.—A very simple apparatus for lubricating the cylinders and valves of engines has been lately developed by Mr. J. G. Donnenworth, of Browning, Mo., of which the main features are,—a hollow piston-rod having the usual outward form and connections provided with a common oil-cup located upon that portion not entering the cylinder or valve-chest. In contemplating this method of oiling the interior surfaces of cylinders and valves, one cannot have other feelings than those of admiration for the striking exhibition of originality displayed by the inventor, in adapting so few and simple means to accomplish an end now considered by the best authorities one of the most important and difficult, connected with the successful operation of the steam motors of to-day.

LOCOMOTIVE CHAIR FOR INVALIDS.—There is a chair for invalids which introduces some novel and useful features and for which Mr. George Arbogast, of Chicago, Ill., has recently received a patent. It consists essentially of a chair having one small rear wheel hung upon a swivel and two larger front guide- or driving-wheels and a hinged and vertically-slotted back, arm-rests adjustably secured at their rear ends to the said back by set-screws, slotted brace-bars pivotally

fastened at their upper ends to the arm rests and adjustably connected at their lower ends by thumb-screws to the lower end of the back, and there is also a leg-rest pivoted at its upper end to the arm-rests. Rising vertically to a convenient height from the front axle, to which their lower ends are secured, are two hand-crank standards, mounted in the upper ends of which are two hand-crank wheels. Power is communicated to the driving-wheels through the medium of a chain which connects the crank-wheels with spracket- or gear-wheels upon the driving axle, having spurs or cogs adopted to mesh with the links of the chain.

IMPROVEMENTS IN SUGAR MANUFACTURE.—An improved method of manufacturing sugar from sorghum, maize and sugar-cane, has been patented by Mr. O. B. Jennings, of Honey Creek, Wis. In the manipulation of sorghum and southern cane, as anticipated by Mr. Jennings, in his specifications, the cane is reduced by a grinding or other process to a dust-like fineness, thereby thoroughly rupturing the juice-cells. And for carrying out this particular process, there is described in the invention an apparatus consisting of numbers of circular-saws for reducing the cane to a proper degree of fineness. Afterwards sprinkling or mixing before defecation, a quantity of dry lime or lime whitewash powder with the finely divided cane, then subjecting the material to a temperature of not less than 212° F. but an average of from 228° F. to 267° F. according to the ripeness. The juice is then removed from the precipitated or woody matter, by washing with water for which vessels and appliances of special adaptation are brought into use.

SPEED GAUGE FOR LOCOMOTIVES.—A gauge or speed recorder to be applied to railway trains has been invented upon entirely new principles by Mr E. R. E. Cowell, of Detroit, Mich. There is a small glass tube used in connection with a receptacle filled with oil and in which a small propeller-wheel is driven at a speed corresponding to that of a predetermined wheel of the engine or car. The device is connected to the car-wheel by a narrow gear-wheel on the axle, meshing into another having attached a flexible shaft leading up to the position assigned the device in the engine-cab. The connection is made to one of the forward truck-axles, as its wheels having no brake do not slide upon the rails. By the use of a device of this nature the engineer has at all times in front of him, the exact speed in miles per minute or hour the train is making, whether the time be daylight or a dark and foggy night, hence he need make no suppositions as to the rate of speed or disobey orders as to speed through unavoidable ignorance. By the successive application of such simple and economical safety apparatus, and by discarding such devices as are no longer considered useful, we shall be led upward step by step until in the near future a locomotive engine will not be considered complete without them.

AN ELEMENT OF FRENCH LITERATURE.

E. RANDALL KNOWLES.

France has a literature so widely divergent in its aspects that we can hardly criticise it as a symmetrical unit. In the spheres of philosophical and purely scientific literature it has not a peer among modern nations. But the very quality which raises it to such a height in these departments debases it in others. The logical frame of the French mind, while absolutely essential in scientific investigation and speculative philosophy is the bane of French poetry. Because the French use the finest logical precision in all scientific research, they are naturally inclined to transplant it to the realm of poetry, where imagination, bodying forth things unknown, should not be governed by the laws of formula or syllogism.

The classical poetry of France will live preserved in the most sacred archives of the national institutions; but it can never become cosmopolitan simply because it has not those affinities with human nature which can break it away from local associations. Racine struggled to liberate himself from the bondage of his own logical inclinations. We cannot but believe that it was the ambition of his life to bequeath to literature, in the portraiture of some of his characters, a legacy of true universal life. But in his constructions he is tethered by a chain which holds him near his starting point. His original conceptions are vivid. They are ofttimes the outgrowth of the profoundest genius, but when we view the lights and shades of the finished painting, we are convinced that it falls far short of the poet's ideal. We are not carried on with the sweep of events until we find ourselves undergoing the same mental transformations, sympathizing with all the moral struggles of the actor, but we are constantly admiring the beauty of the imagery, the musical rythm of the verse. In short we are admiring, not the production but the Racine himself.

Perhaps the most effective manner of representing the difference between the French and English schools of poetry is by a comparison of the prime sources. The rich contrast between the ancient Sagas and Eddas of the North, and the Troubadour poetry of the South exists to-day, though softened by time, between the poetry of the two nations. We do not say that these old poems are absolutely typical. They embody only the strongest features. The former was the product of barren, frozen Scandinavia; the latter sprang from the vine-clad hills and blooming vales of France. The one abounds with brutal passion, ignoble instincts, sublime moral struggles. The other deals with lighter themes. The burden of its song is but the inspiration of surrounding scenery. The delicate tracery of nature, the gentle breezes of the dales, the sweet songs of birds, have been transferred into the music of verse. Naturally, therefore, the prevailing characteristic of the poetry is harmony of structure, logical order, outward symmetry, everything that ministers to the æsthetic taste and delights the senses.

The poet has not launched out into the great deep of human life to discover its boundaries and sound its depths. This species of literature, which flourished in Provence and Normandy from the eleventh to the thirteenth century, followed a tendency which has been developed into a settled literary doctrine in France. The poetry of Matherbe and of Lamartine, though separated by two centuries and a half, does not display only the characteristics of their authors, but the thread of French nationality runs through them all. They have come from that loom which has gathered out of the very centres of French life its love of the beautiful, the histrionic, the superficial, as also the speculative, the scientific, the logical, and woven them into a woof and warp so paradoxical and so diversified that the world offers no parallel. The power of analysis, the delineation of the subtle passions, that probing to the core of the instincts and emotions which convulse the soul, do not thrive in the French mind. They are exotics if they exist at all. Men do not talk as Frenchmen represent them. The poet is not true to nature. Passion welling up from the human heart never vents itself in studied speeches or measured climaxes. That electric current of sympathy which runs through the hearts of English poets and their readers is here broken at the outset. It is impossible, by the very constitution of French genius, to scale the heights of spiritual thought attained by Milton, or to give to weak and erring men the heroism, strength and intellect that is depicted by Shakespeare, or to clothe the elements with those weird and fantastic forms which abound in Dante's Inferno.

Nevertheless, the predominance of the reasoning faculty has a grand purpose to effect. True, in poetry, thought has been sacrificed to style, yet the result is that France can proudly boast of a language so clear and forcible in its diction that it has become the medium of diplomacy, the interpreter of philosophy and the pioneer in scientific research, and it is just in these departments that Europe has yielded France the scepter. So far as truth is attainable by logic, so far as French thinkers can mount from some established dogma or hypothesis to height after height in the search for first principles, they hold undisputed sway. But beyond this they are totally unreliable.

When they have entered that mysterious unknown equipped only with their own poor reason, they find themselves either stricken with impotence or reduced to the alternative of becoming egotists and skeptics. How else shall we account for the long roll of French skeptics from the days of Abelard down to the present time? They have been slow to believe by intuition. Those great truths which our natures attest as being something mightier than all reason, nay, as the very part and parcel of the Divinity Himself, they attempt to reach by rational processes. Thus they have become rebels against their own consciences, and antagonists to the highest truths of Christian philosophy.

COMPARISON OF STRENGTH OF LARGE AND SMALL ANIMALS.

W. N. LOCKINGTON.

M. Delbeuf, in a paper read before the Academie Royale de Belgique, and published in the *Revue Scientique*, reviews the attempts of various naturalists to make comparisons between the strength of large animals and that of small ones, especially insects, and shows that ignorance or forgetfulness of physical laws vitiates all their conclusions.

After a plea for the idea, without which the fact is barren, M. Delbeuf repeats certain statements with which readers of modern zoölogical science are tolerably familiar, such as the following: A flea can jump two hundred times its length; therefore a horse, were its strength proportioned to its weight, could leap the Rocky Mountains, and a whale could spring two hundred leagues in height. An Amazon ant walks about eight feet per minute, but if the progress of a human Amazon were proportioned to her larger size, she could stride over eight leagues in an hour, and if proportioned to her greater weight, she would make the circuit of the globe in about twelve minutes. This seems greatly to the advantage of the insect. What weak creatures vertebrates must be, is the impression conveyed.

But the work increases as the weight. In springing, walking, swimming, or any other activity, the force employed has first to overcome the weight of the body. A man can easily bound a height of two feet, and he weighs as much as a hundred thousand grasshoppers, while a hundred thousand grasshoppers could leap no higher than one—say a foot. This shows that the vertebrate has the advantage. A man represents the volume of fifteen millions of ants, yet can easily move more than three hundred feet a minute, a comparison which gives him forty times more power, bulk for bulk, than the ant possesses. Yet were all the conditions compared, something like equality would probably be the result. Much of the force of a moving man is lost from the inequalities of the way. His body, supported on two points only when at rest, oscillates like a pendulum from one to the other as he moves. The ant crawls close to the ground, and has only a small part of the body unsupported at once. This economizes force at each step, but on the other hand, multiplies the number of steps so greatly, since the smallest irregularity of the surface is a hill to a crawling creature, that the total loss of force is perhaps greater, since it has to slightly raise its body a thousand times or so to clear a space spanned by a man's one step.

By what peculiarity of our minds do we seem to expect the speed of an animal to be in proportion to its size? We do not expect a caravan to move faster than a single horseman, nor an eight hundred pound shot to move twelve thousand eight hundred times farther than an ounce ball. Devout writers speak of a wise provision of Nature. "If," say they, "the speed of a mouse were as

much less than that of a horse as its body is smaller, it would take two steps per second, and be caught at once." Would not Nature have done better for the mouse had she suppressed the cat? Is it not a fact that small animals often owe their escape to their want of swiftness, which enables them to change their direction readily. A man can easily overtake a mouse in a straight run, but the ready change of direction baffles him.

M. Plateau has experimented on the strength of insects, and the facts are unassailable. He has harnessed carabi, necrophori, June-beetles (Melolontha) and other insects in such a way that, with a delicate balance, he can measure their powers of draught. He announces the result that the smallest insects are the strongest proportioned to their size, but that all are enormously strong when compared, bulk for bulk, with vertebrates. A horse can scarcely lift two-thirds of its own weight, while one small species of June-beetle can lift sixty-six times its weight: forty thousand such June-beetles could lift as much as a draught-horse. Were our strength in proportion to this we could play with weights equal to ten times that of a horse, while an elephant could move mountains.

This seems, again, great kindness in Nature to the smaller animal. But all these calculations leave out the elementary mechanical law: "What is gained in power is lost in time." The elevation of a ton to a given height represents an expenditure of an equal amount of force, whether the labor is performed by flea, man or horse. Time supplies lack of strength. We can move as much as a horse by taking more time, and can choose two methods—either to divide the load or use a lever or a pulley. If a horse moves half its own weight three feet in a second, while a June-beetle needs a hundred seconds to convey fifty times its weight an equal distance, the two animals perform equal work proportioned to their weights. True, the cockchafer can hold fourteen times its weight in equilibrium (one small June-beetle sixty-six times), while a horse cannot balance nearly his own weight. But this does not measure the amount of oscillatory motion induced by the respective pulls. For this both should operate against a spring.

A small beetle can escape from under a piece of cardboard a hundred times its weight. Pushing its head under the edge and using it as a lever, it straightens itself on its legs and moves the board just a little, but enough to escape. Of course, we know a horse would be powerless to escape from a load a hundred times its own weight. His head cannot be made into a lever. Give him a lever that will make the time he takes equal to that taken by the insect, and he will throw off the load at a touch. The fact is that in small creatures the lack of muscular energy is replaced by time.

Of two muscles equal in bulk and in energy the shortest moves most weight. If a muscular fiber ten inches in length can move a given weight five inches, ten fibers one inch long will move ten times that weight a distance of half an inch. Thus smaller muscles have an absolutely slower motion, but move a greater proportional weight than larger. The experimenter before mentioned was surprised to find that two grasshoppers, one of which was three times the bulk of

the other, leaped an equal height. This was what might be expected of two animals similarly constructed. The spring was proportioned to the bulk. In experiments on the insects with powerful wings, such as bees, flies, dragon-flies, etc., it was found that the weight they could bear without being forced to descend was in most cases equal to their own. In some cases it was more, but the inequality of rate of flight, had it been taken into the reckoning, would have accounted for this.

Take two creatures of different bulk but built upon exactly the same plan and proportions, say a Brobdignagian and a Lilliputian, and let both show their powers in the arena. Suppose the first to weigh a million times more than the second. If the giant could raise to his shoulder, some thirty-five feet from the ground, a weight twenty thousand pounds, the dwarf can raise to his shoulder, not, as might be thought, a fiftieth of a pound, but two full pounds. The distance raised would be a hundred times less. In a race the Lilliputian, with a hundred skips a second, will travel an equal distance with the giant, who would take but a skip in a second. The leg of the latter weighs a million times the most, but has only ten thousand times as many muscle fibers, each a hundred times longer than those of the dwarf, who thus takes one hundred skips while the giant takes one. The same physical laws apply to all muscles, so that, when all the factors are considered, muscles of the same quality have equal power.—*American Field.*

EDITORIAL NOTES.

THE recent trip to Memphis over the newly finished Kansas City, Springfield & Memphis Railroad was exceedingly instructive and entertaining to all who participated in it. That portion of the line southeast from Springfield was a *terra incognita* to nearly all of the party, and its mountain scenery, its wealth of timber and mineral, its limpid streams, and even its cypress swamps and cane-brakes near the Mississippi River, were a source of surprise to them.

Memphis itself, historic from the succession of its disasters by flood and field, pestilence and hard times, is now a proud monument to the energy and wisdom of its citizens. Her permanently paved streets, admirable system of drainage, immense cotton trade, numerous and extensive manufactories, radiating lines of railroad and crowded levee, all evince a solidity and permanency of growth and condition which were as unexpected as they were gratifying to the visitors. It is too late to give any details this month, but we hope to do so in our next issue.

The hospitality and courtesies of both railroad company and citizens of Memphis were boundless, and all who enjoyed them are now wondering how the people of this city can fittingly return them.

WE expected to publish a full account of the proceeding of the Kansas Academy of Science at its meeting in November, but did not receive the report in time for this number of the REVIEW. The meeting was unusually well attended by the members and the papers read exceptionally good. We hope to give some of them in full next month.

The new officers are Dr. R. J. Brown, President; Prof. F. H. Snow and Joseph Savage, Vice-Presidents; Prof. E. A. Popence, Secretary; Dr. A H. Thompson, Treasurer; Profs. O. H. St. John, J. H. Carruth, and J. T. Lovewell, Curators.

THE Kansas City Academy of Science at its regular meeting the last Friday in November, listened to a masterly address by the well known engineer, Octave Chanute, Esq., upon the Sewerage of Kansas City—Present and Future, with especial reference to its sanitary and economic aspects. As the REVIEW was then in press we were compelled to postpone any notice until next mo th.

THE Third Biennial Session of the Kansas State Social Science Club was held in Topeka, November 8th and 9th, with 150 ladies in attendance. The report of the Treasurer shows r ceipts, $71.22; expenses, $27.10,—leaving a balance on hand of $44.12. Papers were read as follows: By Mrs. Judge Humphrey, of Junction City—"Legal Status of Married Women;" by Miss S. A. Brown, of Lawrence—"Ethics of Schools;" by Mrs. Judge Safford, of Topeka—"The Flower Mission;" by Mrs. B. F. Mudge—"Rudimentary Studies of Nature for Children" read by Mrs. Atwood, of Manhattan, in Mrs, Mudge's ab ence; by Mrs. J. N. Simpson, of Lawrence, and Mrs. Major Hopkins, of Leavenworth, on "Prehistoric America;" by Mrs. Ruth M. Wood, of Leavenworth, on "Physio-Pathological Basis of Mental Culture;" by Mrs. T. D. Thacher, of Topeka, on "Home Decoration;" by Mrs. Wilder, of Manhattan, on "Domestic Services;" and by Mrs. J. K. Hudson, on "Literature for Children." In the evening a grand reception was tendered the Club by the citizens of Topeka, at the Library Hall, where the sessions were held. The Association decided to hold its next meeting in Kansas City.

SINCE our last issue Doctor Marion Simms, in this country, and Prof. C. W. Siemens, of England, have di d, both eminent in their respective professions, and both apparently in the midst of their usefulness.

HAVING recently purchased a set of geological specimens from Professor S. H. Trowbridge, of Glasgow, Mo., and found them exceedingly satisfactory, we take pleasure in recommending him to others who may need such or any kind of natural history specimens for their own cabinets or for those of any school, college, or society. Professor Trowbridge was for many years a teacher of natural science, and his experience is worth a great deal to him in collecting and making up suitable sets for special purposes.

JOHN F. SHORT, late Professor of History and Philosophy in the Ohio State University, died on November 11th at Columbus. He was author of "North Americans of Antiquity" and numbers of leading histories of this country and Europe.

SOME remarkable ruins have been discovered in Tunis by Lieut. Mas enet, who has been dispatched on an archæological mission in the neighborhood of Bograra and El Kantara, in the Gulf of Gabes. The exact spot of the discovery is near Fabella and El Kantara, to the south of the Island of Djerba, and it is believed from the importance and extent of the ruins that they form what was once the capital of the island, many years before the Christian era. The sight is said to be most impressive. The remains of a great temple—from its form pre umably dedicated to Zephyr—have been brought to light near the seashore. They are of marble, and of singular architectural richness, composed in parts of huge blocks measuring more than fifty square yards at their base. Immense columns of red and green marble form the eastern entrance, and there is a square inclosure surrounded with white marble friezes, supported by twisted columns.

THE publisher of the REVIEW has for sale, very low, a large, fine, new parlor organ, suitable also for college chapel, lecture room, or church. It is one of the very best styles, and can be had at a decided bargain.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of the Country and Europe, at a discount of from 15 to 20 per cent off the retail price.*

THE *Atlantic Monthly*, for December, presents the following attractive table of contents: A Roman Singer, XI., XII., F. Marion Crawford. Mary Moody Emerson, Ralph Waldo Emerson. The Initiate, A. F. Recollection of Rome during the Italian Revolution, III, William Chauncy Langdon. O-Be-Joyful Creek and Poverty Gulch, H. H. The World Well Lost, Edmund C. Stedman. Newport, XII-XIV, George Parsons Lathrop. Bermudian Days, Julia C. R. Dorr. Some Alleged Americanisms, Richard Grant White. Luther and His Work, Frederick H. Hedge. Social Washington, Henry Loomis Nelson. Mr. Longfellow and the Artists. Foreign Lands. Recollections of a Naval Officer. Recent Poetry. The Contributors' Club. Books of the Month.

Harper's Magazine for December is a Christmas Number, with an extraordinary wealth and variety of papers, poems, and pictures, by an array of authors and artists (American and English) seldom, if ever, brought together before. This will take the place of the mammoth *Harper's Christmas* of 1882, which will not be repeated this year.

The Number has four extra plates, in addition to its usual 160 well-filled pages. The illustrations alone have cost, it is stated, over $10,000.

The Number opens with a charming Christmas title-page, drawn by Dielman, the artist of "A Girl I Know," in which pretty pictures of Santa Claus and his reindeers and of the Christmas waits are united by a wreath of Christmas holly.

The opening paper is by George William Curtis, the first distinctive article outside of the *Easy Chair* that he has written for years. It deals with "Christmas," old and new, and particularly with how the Pilgrim Fathers declined to celebrate it.

The poet, Whittier, contributes a most worthy and beautiful Christmas poem, "The Supper of St. Gregory," illustrated by F. S. Church.

The Editorial Departments are as bright as usual; the *Drawer* has a pleasant introductory Christmas bit from the pen of Charles Dudley Warner, and several illustrations.

The Publishers announce that this notable Number (in which nothing is continued over from the volume just finished) is but the beginning of a series "unexampled in magazine literature."

As *Harper's Monthly* begins its volumes with the December number, now is the time for our subscribers to avail themselves of our clubbing offer made elsewhere in this issue.

Popular Science Monthly for December offers the following literary and scientific feast: Alexander Von Humboldt, by Emil du Bois-Reymond, (with portrait). Suggestions on Social Subjects, by Professor W. G. Sumner. The Habitation and the Atmosphere, by M. R. Kadau. A Belt of Sun-Spots, by Garrett P. Serviss, (Illustrated). The Morality of Happiness, by Thomas Foster. Genius and Heredity, by M. E. Caro. The Remedies of Nature.—Enteric Disorders, by Felix L. Oswald, M. D. Land-Birds in Mid-Ocean, by George W. Grim. The Illusion of Chance, by William A. Eddy. Female Education from a Medical Point of View, by T. S. Clouston, M. D. The Chemistry of Cookery, by W. Mattieu Williams. Vinous Superstitions, by Dr. Th. Bodin. Malaria and the Progress of Medicine. The Loess-Deposits of Northern China, by Frederick W. Williams. The Natural Setting of Crystals, by J. B. Choate. Surface Characters of the Planet Mars. The New Profession, by Henry Greer. Concentric Rings of Trees, by A. L. Child, M. D. Correspondence: Human Foot-Prints in Stratified Rock, Asthma and its Treatment, Animal Friendships. Editor's Table: Dead-Language Studies Necessarily a Failure, Queer Defenses of the Classics. Literary Notices. Popular Miscellany. Notes.

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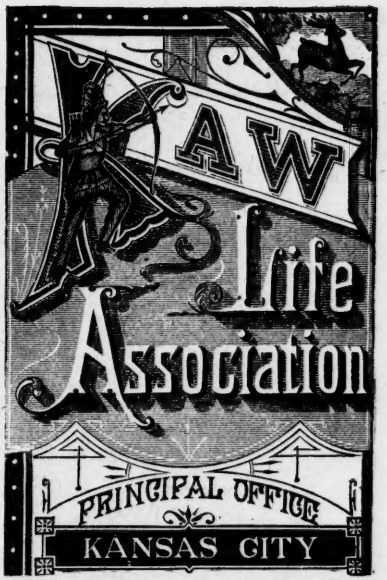

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Worsted Dresses.
Mourning Dresses.
Spring Wraps.
Ladies' Jackets.

Spring Shawls.
Muslin Underwear.
Dressing Sacques.
Children's Dresses.

Children's Jackets.
Table Linens.
Towels, Towelings.
Cloths, Cassimeres.

BLEACHED COTTONS.
PERCALES.
CARPETS. CURTAINS.
LAMBREQUINS.

LACE CURTAINS.
WINDOW SHADES.
WHITE GOODS.
EMBROIDERIES.

Corsets, Hosiery.
Zephyrs, Yarns.
Knitting Silks.
Felts, Canvasses.

Worsted Embroideries.
Lace Tidies.
Embroidered Tidies.
Merino Underwear
Gents' Furnishings.

Mnfg. Departments.

SHIRT MAKING.
DRESS MAKING.
FINE TAILORING.

BULLENE, MOORES & EMERY.